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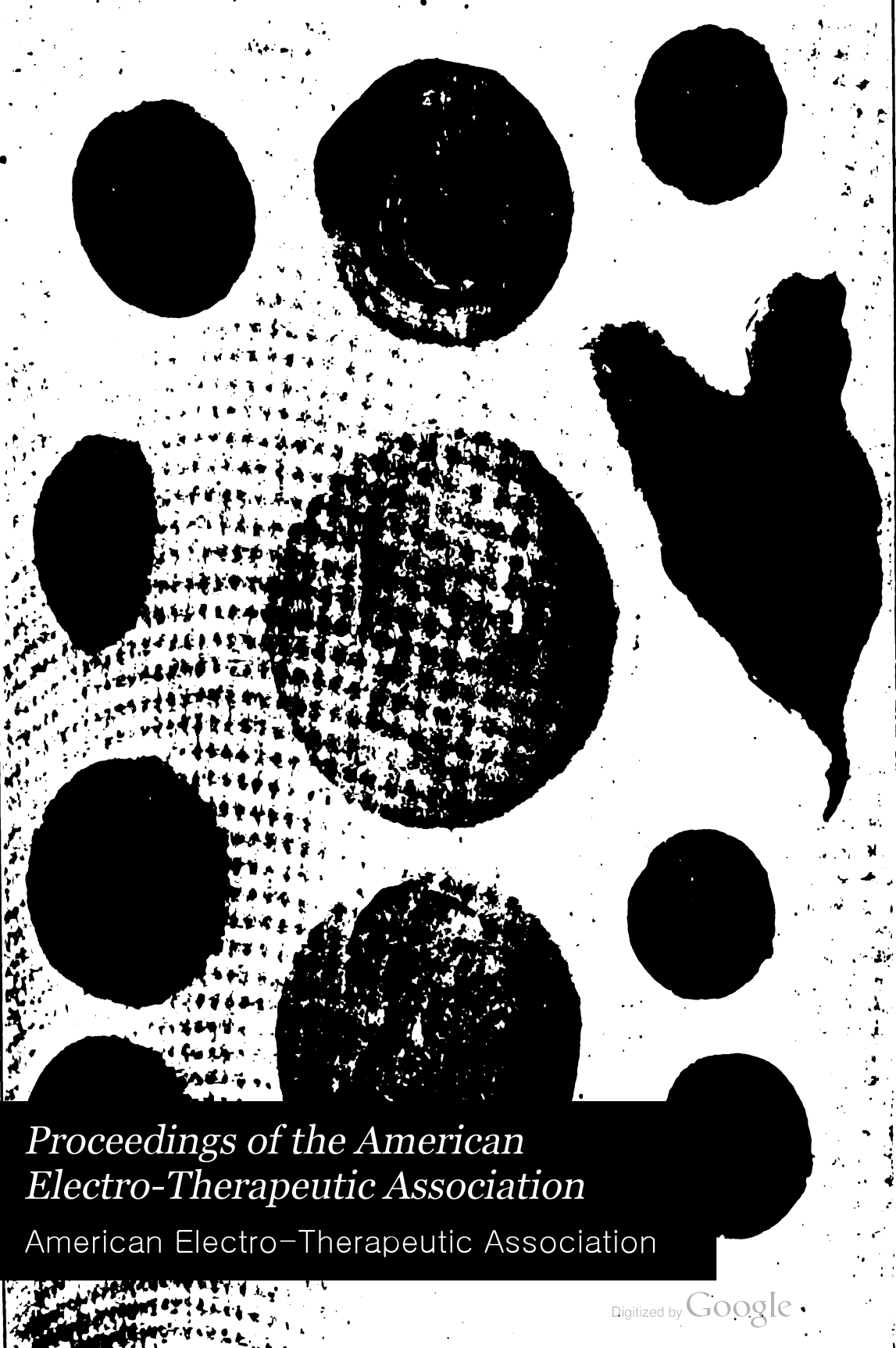

Proceedings of the American Electro-Therapeutic Association

American Electro-Therapeutic Association

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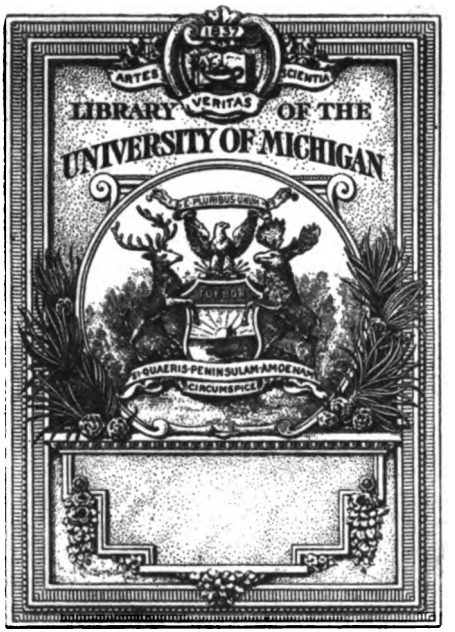

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Transactions

OF THE

American Electro-Therapeutic Association

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TRANSACTIONS

OF THE

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION

NINTH ANNUAL MEETING

HELD AT

WASHINGTON, D. C.

SEPTEMBER 19, 20, AND 21, 1899

TENTH ANNUAL MEETING

HELD AT

NEW YORK CITY

SEPTEMBER 25, 26, AND 27, 1900

PHILADELPHIA
F. A. DAVIS COMPANY, PUBLISHERS
1901

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CONTENTS.

	PAGE
Officers for 1899-1900	viii
Officers for 1900-1901	ix
Committees to Report at Annual Meeting in 1901 at Buffalo	x
List of Officers from Beginning	xi
Honorary Fellows	xii
Fellows	xii
Associate Fellows	xiv
Necrology	xv
In Memoriam	xvi
Minutes of the Proceedings of the Ninth Annual Meeting	1
Address of the President. Francis B. Bishop, M.D.	16
Report of Standing Committee on Direct-Current Generators and Controllers	23
"Power of X-rays to Penetrate through Metals." By Robert Reyburn, A.M., M.D.	29
"Plea for General Use of Voltmeter when Treating Patients by the Galvanic Current." By Walter H. White, M.D.	34
"Electricity in Respiratory and Cardiac Failure, with Case of Paralysis of the Diaphragm." By A. D. Rockwell, M.D.	38
"Modifications of Bottini's Operation for Hypertrophy of Prostate." By Robert Newman, M.D.	48
"Galvanic Effect Produced by High Potential Primary Current." By Dr. R. J. Nunn	59
"Therapeutic Action of High-Frequency Currents in Arthritism." By Dr. Georges Apostoli	63
"Rheumatism." By Charles O. Files, M.D.	73
"Electrical Treatment of Sciatica." By Charles R. Dickson, M.D.	77
"Interesting Cases of Radiography." By Dr. Fouveau de Courmelles	83
"New Treatment for Tuberculous Glands of the Neck." By G. Betton Massey, M.D.	87
"Electricity in the Treatment of Dilatation of the Stomach." By John A. Lichty, M.Ph., M.D.	94
"Electrotherapy." By Dr. W. S. Watson	100

207452

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PAGE

"Electricity in Diseases of the Nose, Throat, and Ear." By W. Scheppegrell, A.M., M.D. 106
"Rheumatoid Arthritis, and Treatment by Electrostatic Sparks." By W. B. Snow, M.D. 114
"Treatment of Cancer by the Massey Method." By G. Betton Massey, M.D. 135
"Modalities of Induced Currents Used in Therapeutics." By William J. Herdman, M.D., LL.D. 145
"Medical Prejudice." By Elihu B. Silvers, M.D. 156
"Some Thoughts on old Crookes Tubes." By Eugene R. Corson, B.S., M.D.. 158
Minutes of the Proceedings of the Tenth Annual Meeting 163
President's Address: "Some of the Needs of this Association." Walter H. White, M.D. 180
Report of Standing Committee on Electrodes 183
"Etiology of Pulmonary Tuberculosis." By S. A. Knopf, M.D. 190
"Modern Treatment of Pulmonary Tuberculosis." By M. J. Brooks, M.D.. 200
"Electric Light in Tuberculosis." By Charles O. Files, M.D. 209
"Electric Light: Its Physiological Action and Therapeutic Value." By W. Freudenthal, M.D. 211
"Report of the Practical Value of Crotte's Method." By Egbert le Fèvre, M.D. 222
"Treatment of Uterine Diseases with Electricity." By Prof. Félix la Torre. 227
"General Office-work of a Gynæcologist." By F. D. Morse, M.D. 247
"Nervous Diseases Peculiar to Women." By G. Betton Massey, M.D. 250
"Use of the Continuous Current and Electrolysis." By Robert Newman, M.D. 253
"Combined Electrization, or Galvano-faradization." By A. D. Rockwell, M.D. 268
"Morton Wave-current: Valuable Addition to Electro-Therapeutics." By William Benham Snow, M.D. 274
"Spark-gap Currents." By William James Morton, M.D. 282
"Cataphoric Treatment of Cancer." By G. Betton Massey, M.D. 297
"Cause of Some Cases of Neurasthenia, and Treatment by Electricity." By Francis B. Bishop, M.D. 327
"Cerebral Neurasthenia, with Special Reference to its Electro-Therapeutics." By Daniel R. Brower, M.D., LL.D. 335
"Electrostatic Treatment of Neurasthenia." By William Benham Snow, M.D. 338
"Electro-Therapeutics in Insanity." By Alfred Tennyson Livingston, M.D. 342

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PAGE

"Gleanings in the Field of Electro-Therapeutics." By Charles O. Files, M.D. 352

"Electricity in the Treatment of Ocular Affections." By Maurice F. Pilgrim, M.D. 356

"General Statistics of Strictures of the Urethra Treated by Electrolysis." By Robert Newman, M.D. 364

"Electro-Therapeutic Sins." By Rev. H. Newman Lawrence 369

"Some New Appliances for X-ray Work." By E. W. Caldwell, E.E. 376

"X-ray Photography." By Eugene R. Corson, B.S., M.D. 378

"Universal Electro-Therapeutic Switch-board." By William J. Herdman, M.D., LL.D. 388

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OFFICERS FOR 1899-1900.

President:

Walter H. White, M.D., 220 Marlboro Street, Boston, Mass.

Vice-Presidents:

D. Percy Hickling, M.D., Washington, D. C.
Charles O. Files, M.D., Portland, Me.

Secretary:

George E. Bill, M.D., 17 S. Third Street, Harrisburg, Pa.

Treasurer:

R. J. Nunn, M.D., Savannah, Ga.

Executive Council:

(Three Years.)

Charles R. Dickson, M.D., Toronto, Can.
Frederick Schavoir, M.D., Stamford, Conn.

(Two Years.)

Robert Newman, M.D., New York City.
G. Betton Massey, M.D., Philadelphia.

(One Year.)

William J. Morton, M.D., New York City.
A. D. Rockwell, M.D., New York City.

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OFFICERS FOR 1900-1901.

President:

Ernest Wende, M.D., Buffalo, N. Y.

Vice-Presidents:

Frederick H. Morse, M.D., Melrose, Mass.
D. R. Brower, M.D., Chicago, Ill.

Secretary:

George E. Bill, M.D., 17 S. Third Street, Harrisburg, Pa.

Treasurer:

R. J. Nunn, M.D., 119 1/2 York Street, Savannah, Ga.

Executive Council:

(Three Years.)

Francis B. Bishop, M.D., Washington, D. C.
Walter H. White, M.D., Boston, Mass.

(Two Years.)

Charles R. Dickson, M.D., Toronto, Can.
Frederick Schavoir, M.D., Stamford, Conn.

(One Year.)

Robert Newman, M.D., New York City.
G. Betton Massey, M.D., Philadelphia, Pa.

The next meeting of the Association will be at Buffalo, N. Y., September 24, 25, and 26, 1901.

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COMMITTEES.

COMMITTEES
TO REPORT AT THE ANNUAL MEETING IN 1901 AT BUFFALO.

On Induction-coils and Alternators:

Margaret A. Cleaves, M.D., *Chairman,*
79 Madison Ave., New York City.

Mr. A. E. Kennelly, F.R.A.S. — Mr. Burton Kinraide, E.E.

On Meters:

Emil Heuel, M.D., *Chairman.*
352 Willis Ave., New York City.

Mr. Charles T. Scott, M.A.I., E.E. — Mr. William J. Jenks, E.E.

On Constant-Current Generators and Controllers:

William J. Herdman, M.D., *Chairman,*
48 E. Huron St., Ann Arbor, Mich.

Robert Newman, M.D. — Mr. R. G. Brown, E.E.

On Static Machines and Condensers:

William J. Morton, M.D., *Chairman,*
17 E. Twenty-eighth St., New York City.

Frederick Schavoir, M.D. — G. Betton Massey, M.D.

On Electrodes:

Charles Rea Dickson, M.D., *Chairman,*
296 Sherbourne St., Toronto, Can.

Walter H. White, M.D. — Mr. R. G. Brown, E.E.

On Electric-Light Apparatus for Diagnosis and Therapy, and the Roentgen X-ray:

Charles O. Files, M.D., *Chairman,*
Portland, Maine.

W. Scheppegrell, M.D., A.M. — Frederick H. Morse, M.D.

On Cataphoresis:

Mr. John J. Carty, E.E., *Chairman,*
18 Cortland St., New York City.

Francis B. Bishop, M.D. — D. R. Brower, M.D.

On Arrangements:

Henry R. Hopkins, M.D., *Chairman,*
433 Franklin St., Buffalo, N. Y.

W. W. Potter, M.D. — W. D. Greene, M.D.
Mr. Newcomb Carlton, C.E. — Mr. Augustus Schneider.
A. W. Bayliss, M.D. — Edward Clark, M.D.
Willis G. Gregory, M.D. — Franklin C. Gram, M.D.

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LIST OF OFFICERS

FROM THE

ORGANIZATION OF THE ASSOCIATION TO THE PRESENT TIME.

Year.	*President.*	*Vice-Presidents.*	*Secretary.*	*Treasurer.*
1891.	G. Betton Massey.	Wm. J. Morton. A. H. Goelet.	Wm. H. Walling.	R. J. Nunn.
1892.	Wm. J. Morton.	A. H. Goelet. Wm. F. Hutchinson.	H. R. Bigelow.	R. J. Nunn.
1893.	A. H. Goelet.	Wm. F. Hutchinson. Wm. J. Herdman.	M. A. Cleaves.	R. J. Nunn.
1894.	Wm. J. Herdman.	Franklin H. Martin. A. Lapthorn Smith.	M. A. Cleaves.	R. J. Nunn.
1895.	A. Lapthorn Smith.	J. H. Kellogg. C. R. Dickson.	Emil Heuel.	R. J. Nunn.
1896.	Robert Newman.	Holford Walker. D. B. D. Beaver.	Emil Heuel.	R. J. Nunn.
1897.	Wm. T. Bishop.	Emil Heuel. F. B. Bishop.	Max Einhorn.	R. J. Nunn.
1898.	Chas. R. Dickson.	Frederick Schavoir. Caleb Brown.	John Gerin.	R. J. Nunn.
1899.	Francis B. Bishop.	Ernest Wende. W. H. White.	John Gerin.	R. J. Nunn.
1900.	Walter H. White.	D. Percy Hickling. Chas. O. Files.	George E. Bill.	R. J. Nunn.
1901.	Ernest Wende.	Frederick H. Morse. Daniel R. Brower.	George E. Bill.	R. J. Nunn.

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HONORARY FELLOWS.

D'Arsonval, Prof. Dr. A., 28 Avenue de l'Observation, Paris, France.
Benedict, Prof. Dr. I., Franziskanerplatz 5, Vienna, Austria.
Bergonie, Prof. Dr. J., 9 bis Rue du Temple, Bordeaux, France.
Carhart, Prof. H. S., University of Michigan, Ann Arbor, Mich.
Carty, John J., E.E., Vice-President of New York Electrical Society, 15 Dey Street, New York City, N. Y.
Clark, Dr. W. Bruce, M.A., M.B., F.R.C.S., 51 Harley Street, W., London, England.
Dolbear, Prof. Amos E., A.B., A.M., M.E., Ph.D., Tufts College, Mass.
Gautier, Dr. Georges, 7 bis Rue du Louvre, Paris, France.
Houston, Prof. Edwin J., Ph.D., 1809 Spring Garden Street, Philadelphia, Pa.
Jenks, William J., E.E., 120 Broadway, New York, N. Y.
Keith, Dr. Skene, 42 Charles Street, Berkeley Sq., W., London, England.
Kennelly, A. E., Sc.D., F.R.A.S., Crozer Building, Philadelphia, Pa.
Langley, Prof. W., Case School of Applied Science, Cleveland, O.
Larat, Dr. J., Laboratoire d'Electrothérapie, 3 Place du Théatre Français, Paris, France.
La Torre, Dr. Felice, 3 Via XX Settembre, Rome, Italy.
Massin, Dr. Wassli Astrow, St. Petersburg, Russia.
McClure, Dr. Henry, Norwich, England.
Mitchell, Dr. S. Weir, LL.D., 1524 Walnut Street, Philadelphia, Pa.
Parsons, Dr. J. Inglis, 3 Queen Street, Mayfair, W., London, England.
Soutakis, Dr., Constantinople, Turkey.
Temesvary, Dr. Rudolff, Erzebetkorut 32, Budapest vii, Hungary.
Tesla, Nikola, E.E., 55 W. Twenty-seventh Street, New York, N. Y.
Thomson, Prof. Elihu, Lynn, Mass.
Tripier, Dr. A., Paris, France.

FELLOWS.

Bayliss, Dr. S. W., 592 Spring Street, Buffalo, N. Y.
Bigelow, Dr. Horatio R., Washington, D. C.
Bill, Dr. George E., Harrisburg, Pa.
Bishop, Dr. Francis B., 1913 I Street, N. W., Washington, D. C. (President in 1899.)
Bishop, Dr. William T., Harrisburg, Pa. (President in 1897.)
Brady, Dr. William F., Scranton, Pa.
Brower, Dr. D. R., 597 Jackson Boulevard, Chicago, Ill.

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Charlton, Dr. Thomas J., 220 Ogelthorpe Avenue E., Savannah, Ga.
*Cleaves, Dr. Margaret A., 78 Madison Avenue, New York City.
Coe, Dr. Henry Waldo, 714 Marquam Building, Portland, Ore.
Coope, Dr. F. A., 114 Sycamore Street, Oil City, Pa.
Corson, Dr. Eugene R., 115 Jones Street, Savannah, Ga.
Crossfield, Dr. Fred. S., Hartford, Conn.
Davis, Dr. J. Griffith, 200 West Fourteenth Street, New York City.
Delphey, Dr. Eden V., 400 West One Hundred and Fifty-seventh Street, New York City.
Dickson, Dr. Charles R., 296 Sherbourne Street, Toronto, Canada. (President in 1898.)
Douglas, Dr. O. B., 123 East Thirty-sixth Street, New York City.
Evarts, Dr. Raymond M., Silver Creek, N. Y.
Fairbanks, Dr. C. O., 25 West Forty-fifth Street, New York City.
Files, Dr. Charles O., Portland, Me.
Ford, Dr. Willis E., 266 Genesee Street, Utica, N. Y.
Gehrung, Dr. E. C., N. E. corner Westminster Place and Vandeventer Avenue, St. Louis, Mo.
Gerin, Dr. John, 68 North Street, Auburn, N. Y.
Gibson, Dr. J. D., Birmingham, Ala.
Hahn, Dr. H. H., 304 East Federal Street, Youngstown, Ohio.
Hammond, Dr. G. M., 58 West Forty-fifth Street, New York City.
Herdman, Dr. William J., 48 East Huron Street, Ann Arbor, Mich. (President in 1894.)
Heuel, Dr. Emil, 350 Willis Avenue, New York City.
Hickling, Dr. D. Percy, 221 Third Street, N. W., Washington, D. C.
Huntley, Dr. James F., 10 Broad Street, Oneida, N. Y.
Judd, Dr. L. D., 3603 Powelton Avenue, Philadelphia, Pa.
Kellogg, Dr. J. H., Battle Creek, Mich.
Koempel, Dr. Franz, 133 East Fifty-seventh Street, New York City.
Lawhead, Dr. H. D., Woodland, Yolo County, Cal.
Lichty, Dr. John A., Pittsburgh, Pa.
Livingston, Dr. Alfred T., Jamestown, N. Y.
Lodor, Dr. Charles H., 3136 Indiana Avenue, Chicago, Ill.
Martingy, Dr. Adelstan de, 406 Sherbrooke Street, Montreal, Can.
Martin, Dr. Franklin, 34 Washington Street, Chicago, Ill.
*Massey, Dr. G. Betton, 1831 Chestnut Street, Philadelphia, Pa. (President in 1891.)
McGinnis, Dr. E. H. L., 329 Amsterdam Avenue, New York City.
Miller, Dr. William, Riverside, Cal.
Millspaugh, Dr. Daniel T., Paterson, N. J.
Morse, Dr. Frederick D., Melrose, Mass.
*Morton, Dr. William J., 17 East Twenty-eighth Street, New York City. (President in 1892).
*Newman, Dr. Robert, 148 West Seventy-third Street, New York City. (President in 1896.)
Neylan, Dr. D. J., 172 Hope Street, Bristol, R. I.
Nunn, Dr. Richard J., 5 York Street, Savannah, Ga.

---

*At the first meeting, and founders of the Association.

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Osman, Dr. C. Frank, 21 Mayfield Street, Dorchester, Boston, Mass.
Phelps, Dr. O. S., Battle Creek, Mich.
Pilgrim, Dr. Maurice F., 419 Boylston Street, Boston, Mass.
Pitcher, Dr. Herbert F., Haverhill, Mass.
Pope, Dr. Curran, 115 West Chestnut Street, Louisville, Ky.
Powell, Dr. Stephen C., Newport, R. I.
Repetti, Dr. F. F., 149 B Street, S. E., Washington, D. C.
Reville, Dr. Laura M., 1017 Fourteenth Street, N. W., Washington, D. C.
Reyburn, Dr. Robert, 714 Thirteenth Street, Washington, D. C.
Robinson, Dr. W. F., 59 Washington Avenue, Albany, N. Y.
Rockwell, Dr. A. D., 25 East Forty-fourth Street, New York City.
Schavoir, Dr. F., 8 Atlantic Street, Stamford, Conn.
Scheppegrell, Dr. W., A.M., 3723 Prytania Street, New Orleans, La.
Shannon, Dr. J. E., 4 West Main Street, Sharon, Tenn.
Sherman, Dr. A. L., 325 Ninth Street, Brooklyn, N. Y.
Silvers, Dr. Elihu B., corner Irving and Grand Streets, Rahway, N. J.
Simmons, Dr. Alpheus B., Savannah, Ga.
Smith, Dr. Elijah W., 213-15 Rose Dispensary Building, Terre Haute, Ind.
Snow, Dr. William Benham, 154 West Thirty-fourth Street, New York City.
Thomas, Dr. J. G., Mobile, Ala.
Wallace, Dr. Frank H., 711 Boylston Street, Boston, Mass.
Watson, Dr. William S., Fishkill-on-Hudson, N. Y.
Weichselbaum, Dr. Jacob, 111 Whitaker Street, Savannah, Ga.
Weigel, Dr. Louis A., 209 East Avenue, Rochester, N. Y.
Wende, Dr. Ernest, 471 Delaware Avenue, Buffalo, N. Y. (President in 1900-01.)
White, Dr. W. H., 220 Marlborough Street, Boston, Mass. (President in 1900.)
Whitwell, Dr. W. S., 30 West Eleventh Street, New York City.
Wilson, Dr. S. Fairweather, 947 Dorchester Street, Montreal, Can.
Woolsey, Dr. Elliot H., 1103 1/2, Oakland, Cal.

ASSOCIATE FELLOWS.

Brown, R. G., E.E., 158 Montague Street, Brooklyn, N. Y.
Cabot, John A., E.E., Chief Electrician, Board of Administration, Cincinnati, Ohio.
Hammer, Edwin W., E.E., 20 Broadway, New York City.
Kenraide, Burton, E.E., 38 Park Avenue, Jamaica Plain, Boston, Mass.
Lawrence, Rev. Newman, M.I., E.E., Stapleton, N. Y.
Scott, Charles T., M.A.I., E.E., 6214 Sellers Street, Pittsburgh, Pa.

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NECROLOGY.

HONORARY FELLOWS.

Dr. Onimus, Paris, France, 1896.
Dr. E. du Bois-Reymond, Berlin, Germany, 1896.
Dr. Thomas Keith, London, England, 1897.
Dr. Georges Apostoli, Paris, France, 1900.

FELLOWS.

Dr. John Chambers, Indianapolis, Ind., 1892.
Dr. Plym S. Hayes, Chicago, Ill., 1893.
Dr. William F. Hutchinson, Providence, R. I., 1893.
Dr. S. T. Anderson, Bloomington, Ill., 1896.
Dr. Charles W. Wiley, Vineland, N. J., 1897.
Dr. Caleb Brown, Sac City, Iowa, 1899.
Dr. E. A. Perkins, Boston, Mass., 1900.
Dr. M. J. Grier, Philadelphia, Pa., 1900.

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IN MEMORIAM.

Resolutions passed by the American Electro-Therapeutic Association regarding the death of Dr. Georges Apostoli, of Paris, France.

Resolved, that we, the American Electro-Therapeutic Association, hereby record our sincere sorrow at the death of Dr. Georges Apostoli; that his death has deprived Electro-Therapeutics of one of the foremost of its able defenders, one of its highest types of practitioners, and one whose work was a direct gift to humanity of a valuable procedure for the cure of disease.

In his death we, as electro-therapeutists, and the medical profession, as a whole, have suffered a distinct loss.

In recognition of our sorrow and in admiration of his career as a physician, we resolve that this resolution be spread upon the minutes of this association, and be transmitted by our secretary to Dr. Apostoli's family.

(Signed) DR. WILLIAM J. MORTON, *Chairman.*
DR. WALTER H. WHITE, *President.*
DR. GEORGE E. BILL, *Secretary.*

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MINUTES OF THE PROCEEDINGS

OF THE

NINTH ANNUAL MEETING

OF THE

American Electro-Therapeutic Association.

HELD AT WILLARD'S HOTEL, WASHINGTON, D.C., SEPTEMBER 19, 20, AND 21, 1899.

FRANCIS B. BISHOP, M.D., of Washington, D. C., President.

FIRST DAY—Tuesday, September 19th.

Morning—Executive Session.—The meeting was called to order by Vice-President Dr. Walter H. White, of Boston, Mass., at 9.45 A.M., in the absence, through illness, of President Bishop.

On motion of Dr. G. Betton Massey, of Philadelphia, Pa., Dr. Charles R. Dickson, of Toronto, Canada, was appointed secretary *pro tem.*

The Report of the Executive Council was presented by Dr. C. R. Dickson.

The Executive Council beg leave to submit the following report:—

The council met in Buffalo, N. Y., on September 15, 1898, immediately upon adjournment of the eighth annual meeting, to consider the publication of the transactions and other business relating to the conduct of the Washington meeting. The second meeting of council was held in New York City, N. Y., on May 29, 1899, the business of the association in the *interim* being conducted by correspondence and voting by mail, all of which was confirmed at this second meeting. The published Transactions of the Association for 1898 contain the constitution and by-laws as amended to date. The council advises that Article No. 20 of constitution, relating to place of meeting, be not amended.

The secretary of the association was instructed to inform the secretary of the American Association of Medical Examiners that Drs. W. J. Herdman, Ernest Wende, and W. T. Bishop had been appointed

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a committee to present and urge the importance of adding to the college-curriculum the subject of electro-therapeutics.

The president was requested to recommend delegates to the American Medical Association.

Dr. D. Percy Hickling, Chairman of Committee on Arrangements, appeared before the council to report progress. The preparation and printing of the program were intrusted to the president and Committee of Arrangements.

It was decided that a form of notification to members in arrears be considered and submitted to the association for approval.

The secretary was instructed to pay accounts as money was received, bills incurred before the annual meeting to be settled before that meeting, and that he should make a full report of all receipts and expenditures.

The employment of a stenographer was intrusted to the president and secretary.

Mr. John J. Carty, E.E., Associate Fellow, is recommended for election as Honorary Fellow.

Dr. Gustavus M. Blech, of Chicago, Ill.; Dr. William F. Brady, of Scranton, Pa.; Dr. Dudley Fulton, of Battle Creek, Mich.; Dr. Albert C. Geyser, of New York, N. Y.; Dr. L. D. Judd, of Philadelphia, Pa.; Dr. A. G. Minshall, of Northampton, Mass.; Dr. Maurice F. Pilgrim, of Boston, Mass.; Dr. Elijah W. Smith, of Terre Haute, Ind.; Dr. William B. Snow, of New York, N. Y., are recommended for election as Fellows.

It is recommended that no additions be made to the list of Associate Fellows.

To lessen expense of correspondence the Chairman of Committee on Arrangements was requested to inclose a notification from the secretary in his letters to members.

On motion of Dr. C. R. Dickson, seconded by Dr. G. Betton Massey, the report was adopted.

On motion of Dr. G. Betton Massey, seconded by Dr. A. D. Rockwell, of New York, the secretary was instructed to cast the ballot of the association for the election of the candidates recommended by the council, which being done they were declared duly elected members of the association.

The consideration of the reports of standing committees was deferred to a future session.

On motion of Dr. G. Betton Massey, seconded by Dr. William

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T. Bishop, the secretary was instructed to write to Mrs. Francis B. Bishop, expressing regret for the illness of her husband and the best wishes of the association for his recovery.

On motion, Dr. Frederick Schavoir, of Stamford, Conn., was requested to receive fees and attend to the registration of members in the absence of the secretary.

The Executive Session then adjourned.

General Session.—The association went into General Session at 10.30 A.M. The chairman (Vice-President White) introduced Hon. John B. Wight, Commissioner of District of Columbia, who delivered the address of welcome.

ADDRESS OF WELCOME.

BY COMMISSIONER WIGHT.

Mr. President, Ladies, and Gentlemen: It gives me a great deal of pleasure to welcome this society to the national capital. It always gives us pleasure to have our friends come here to Washington to hold their conventions, to see something of the beauties of this city, and to enjoy its hospitality. I had the pleasure myself, a few months ago, of being a delegate to the city of Detroit, and there I changed my position from that which I usually occupy as the one delivering the address to that of the one hearing it. We were welcomed by the Governor of the State, by a prominent citizen, and by the mayor of the city, and I was surprised and pleased to find that the address of welcome, which sounds so stolid, oftentimes, and matter of fact, to the one who delivers it, is really a very pleasant thing to those who hear it.

Whatever address of welcome may have been delivered in any other place, or whatever may have been said in welcoming you to other cities, here at least you can have a unique welcome. The gentlemen there may address you and welcome you to their cities, but when you come here we welcome you to your own city. You, as representatives of the people of the United States, own more than one-half of the District of Columbia. There is, however, a law of equalization that pervades all things, and it prevails here, to the satisfaction, at least, of the citizens of the District: for, while you own the biggest half of the territory, we pay the biggest half of the bills. So we are all right.

Every address of welcome includes in it, I believe, a statement referring to the beauties of the city, and the advantages of it, and all

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that sort of thing. It would be an idle repetition, perhaps, for me to go into those things, and tell you about them. You will find them out for yourselves. Whatever there is of merit, and whatever there is of beauty, in Washington, and whatever there is still undeveloped, you have a part in. Your constituents here in Congress are the men who legislate for the District of Columbia. The commissioners are those who carry out the laws of Congress. Just to the extent that you are willing that your representatives in Congress shall legislate liberally and generously for the upbuilding and development of this national capital,—than which I veritably believe there is no more beautiful city, no city that has more magnificent possibilities in its development,—just to that extent will this city take its rank with the other capitals of the world, in beauty, in magnificence, and in desirability of residence.

Now we really feel, gentlemen, that this is a good place for you to meet, because we hope it will give you some ideas and suggestions as to how to get along with your patients. Whenever you feel that you have touched bottom, and cannot do anything else with them, just send them down here to spend the winter. We will guarantee you enough pleasure and diversion to take their minds off themselves, and afford them some relief. We will guarantee to send them back with enough dyspepsia to keep you busy during the summer, and then we will look for them again during the following winter.

Now, I don't know that I can add anything to the hospitality and sincerity of my welcome by speaking longer. There is a great deal to be seen here. If you have timed your convention about the equinoctial, you can't blame us if it rains a little; but the hospitality of our welcome, gentlemen, here, is well known. I am sure you are going to have a pleasant time, and I hope it will be sufficiently pleasant to induce you to come back again. (Applause.)

Response by Dr. Dickson.

Mr. Chairman, Honorable Mr. Wight, and Fellows of the American Electro-Therapeutic Association: It is with mingled feelings of joy and sadness that I perform this task. We are delighted to receive a welcome from our honored friend, to this city of magnificent distances; but we are sad to miss from the presiding chair the face and the form of our beloved president, Dr. Bishop. And, therefore, while we would naturally feel light-hearted at this hearty reception, we must feel very

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sad that this cloud, not of the heavens, but of the earth, should fall upon us, and that we should miss the genial smile and the hearty words which we had expected to have heard to greet us from the chair, of Dr. Bishop. And I am sure that we all hope he may be very, very speedily restored to health and strength, and to a life of great usefulness in this association.

I was struck with what our honored friend said about being in the position of delivering the address of welcome, and receiving addresses of welcome; and I had thought of a little paraphrase that comes to mind very often—that "it is more blessed to give than to receive"; and I thought this was very apropos at this time. We all expect great things of Washington. It is the centre to which our thoughts constantly turn,—not only the thoughts of our American brethren, but our brethren from beyond the imaginary line, of which I am a humble representative. I come from the land of the North Pole—Canada. Although our climate is cold, our hearts are warm. We have a great deal of Irish blood up there, some of which I possess myself, and we are very much delighted when we receive a warm welcome. The association has been warmly welcomed at each place of meeting, and therefore here we are pleased to know that this program is to be continued, and we are all anxious to go over that grand building—one which I am informed is one of the grandest in the world of its kind—the Congressional Library. I believe that your Congressional Library is supposed to be the finest library of the sort in existence. I have been so informed by competent authorities—not American authorities, either: European authorities, if you please. Therefore we are anxious to see this, and all the other great sights of your city. You have so many points of interest that I greatly fear that our sessions will be neglected on account of the sight-seeing. However, I shall urge our members not to do this; and as we have already a very large program, I will not detain you any longer. Again I thank you, on behalf of the association, sir, for the hearty welcome to the city, and I hope that all our members will behave ourselves. At one place we were given the freedom of the city, and I believe that the police were instructed not to make any arrests of men carrying the association badge. I hope it will not be necessary to make any arrests on this occasion.

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ADDRESS BY REV. D. G. STAFFORD.

Hon. Mr. Commissioner, Mr. President, Ladies, and Gentlemen: Permit me for a moment to turn your attention from these pleasant amenities that have been exchanged, to what may be, perhaps, a little more serious, but possibly in line with the work that you are to undertake in this meeting.

The field of science is so vast, and the mind of man is so limited, that man cannot, wonderful as the scope and comprehension of man's intellect is,—he cannot take it all in. And therefore, necessarily, he must divide it in parts, and, when he would make progress in any particular branch of science, he must concentrate his mind upon that particular branch and devote all his time to it.

Now, the dignity of a profession, and the dignity of science, is measured according to its object. The object of law, for example, is justice. The object of the statesman is the ideal state. The object of the philosopher is intellectual truth. The object of medical science is life.

What is the relation of the medical man to this mysterious thing that we call life, which comes to us without our asking, and goes away without our bidding,—of which we are at the same time the master and the slave? That was beautifully illustrated in that incident with which you are all familiar, that occurred in the pest-house in the East, when the greatest conqueror of modern times, touched by the suffering of those miserable men, who could not be benefited by any possible human accessories, or any possible medical discoveries known to that time, said to the medical man: "Why do you not put these wretches out of their sufferings, by death?" And the answer of the man of science to the man of power was such as it always should be. He answered boldly, saying: "Sir, the object of my profession is to preserve life, and not to destroy it." Beautiful words, that ought to be inscribed over the portals of every medical school, and written on the title-page of every text-book, and ought to shine as a halo around the brow of every member of that noble science: "The object of my profession, sir, is to preserve life, and not to destroy it."

But in order to effect that end, in order to arrive at that end, scientific investigation is necessary. For that mysterious union that exists between the human body and nature, by which man is related to nature and by which nature becomes his table, from which he derives the consciousness and powers of his life, and in whose mysterious solitudes there are concealed also properties, as science may well hope,

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that have the power to cure all the evils that flesh is heir to—according to that mysterious relationship between man and nature, man may hope, by scientific investigation, to discover things that are necessary to remedy, I say, all the evils that flesh is heir to.

Now, if this scientific investigation is necessary to arrive at this end, in which your branch of science is so eminent a part at the present day, the scientific man should have the most absolute freedom. Men of great minds move in large spaces. They need elbow-room. They must not be hampered by any consideration other than that which is the present object of their investigations. And all the world ought to be willing to concede to them, and must concede to them, the most absolute freedom. And though it be apparent that the proposition advocated for the time, and the theory advanced, may be erroneous, and is only a step toward something higher and better, if we insist upon a man attaining truth immediately, then we shall insist upon the impossible; and if we are not willing to tolerate the error for the time being, in order to arrive at truth, then what would be the result? We must close the library and close the folio, and error will be banished from the world, but also the truth, toward which that error would be the stepping-stone. We do not climb the mountain directly up to the summit, but we must go around it, and it is only when we get to the summit that we see the vision of beauty and the glory of the universe that is round about it. And as we cannot walk directly up to the summit, but must needs go around with laborious mounting in order to attain the summit, so, the human mind being so limited, we cannot march directly to truth, but we must follow what I may call the devious ways, sometimes even the way of mistake and error; but that mistake and error will lead us to something better, until finally we will arrive at the goal of truth. And for that purpose absolute freedom of scientific investigation is necessary. Not, indeed, that we mean to insist upon an hypothesis as a truth, nor insist upon a theory as a fact. But the world, and even the theological world, must have patience during the investigation, and wait for the result, and wait for the facts, being sure that, as the human mind is logical, error is short-lived, and that as nature is an harmonious whole, which the investigation of it supposes, and as there must necessarily, in order to make science possible, be design and harmony in nature, then the result must ultimately be good. *Nemo repente fuit turpissimus.*[1] "No man can be absolutely free

[1] Juvenal, "Satire II."

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from imperfection." And Cardinal Newman, in a remarkable lecture before the University in Edinburgh, points to the fact with admiration, that even the church, which is intolerant in matters of error, yet has permitted errors in the works of individual theologians, because of the benefit of the result, to the cause of truth, from the general work. The general result of their work brings about improvement. And surely in all these things we must have that broadness and liberality of spirit. Provided men start with the right disposition and with the right principles, we must have patience with what may appear to be imperfect, what may even, according to our supposition, be erroneous; knowing that one man cannot in a life-time arrive at the result of even one investigation, perhaps, and that it is only after patient effort and laborious investigations on the part, perhaps, of several generations, that the truth is finally reached, and the goal finally arrived at. So that I claim for the scientific men the most absolute freedom of scientific investigation, provided they enter upon it with a true scientific spirit, such as that which animates you,—knowing that the ultimate result and outcome of the general scientific investigation of the age must be good, because nature is harmonious, and the mind of man is logical.

And surely, gentlemen, if he who writes a song benefits the human race, if the poet who writes a poem elevates the human race and is a benefit to the race, if the orator who is able to lift men out of themselves for the time being and lift them up to his plane of thought and to his ecstasy of feeling, is a benefit to his time, what is he to humanity who, by sacrifice of himself, by his labor, by his intelligence, by his efforts, finally discovers something that alleviates human pain or prolongs human life? Surely all the benedictions of the human race, and of all the multitudes of generations yet unborn, are not sufficient to reward him.

The work, then, is Christlike—the illumination of the intelligence, and the alleviation of human suffering; nothing greater, nothing better.

And therefore it is, with this disposition, with this high aim and this high conception of your profession, that you go about it, knowing that it is not merely a profession, not merely a calling pursued for any sordid purpose of mere success in the world, of mere pecuniary emolument, but that it is the one link, the one factor, the one little thing, perhaps, in a great and vast edifice that is being built up, the outcome and result of which no man can foretell; but, animated by that which

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has gone before, we may hope that the result for time to come is going to be something wiser and stronger, highly beneficent to the human race.

Let us, therefore, gentlemen, set to work honestly, knowing that you are a part in a thing in which, indeed, you may not see the result of your individual efforts, but you are contributing toward a great result, that time and logical historical development is going to bring about. And the consciousness that you have part in that ought to sustain you in your discouragements, and animate you in your successes. Be like those men who in the middle ages went from city to city, to build the great cathedrals that now ornament Europe. Whole villages emigrated to the spot where the cathedral was to be erected, and one generation was content to bring the wall up to a certain point, knowing that they could not complete that work, but they were content to place one stone in the wall, and satisfied that they had that much part in the work, knowing that some day the end would be reached, and the work completed. So let it be with you. So carry on your investigations, knowing that in the end the result is going to be highly beneficial to civilization, highly beneficial to the human race, and he who is of benefit to the human race has not lived his life in vain. (Applause.)

ADDRESS OF THE CHAIRMAN OF THE COMMITTEE OF ARRANGEMENTS.

DR. D. PERCY HICKLING, Washington, D. C.

Mr. President, Members of the Association, Ladies, and Gentlemen: It becomes my very pleasant duty to welcome you, on behalf of the Committee of Arrangements, to the city of Washington, and we sincerely hope that your stay with us will be a pleasant one; and, judging by the program which Dr. Bishop has prepared (for the preparation of the program has been almost entirely by him), I am sure it will be a very profitable meeting. The papers on the program, of course, speak for themselves. The entertainment it is possibly my duty to speak of especially. Washington, as has been intimated by the President of the Board of Commissioners, Mr. Wight, is a peculiar city. It is not a city that entertains guests, because every visitor belongs to us. So that there is a feeling among the profession which sometimes has been considered cold, but I assure you it is not so. They are interested in medicine and they are interested in electro-therapeutics, and they are interested in our visitors. But conventions are of daily occurrence.

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Large crowds come and go, and we are used to them. But I assure you that we are glad to have you with us, and that the numerous sights, the public buildings, the affairs of national interest that we have to offer are equal to those which you will find in other directions, in many other cities. To that end we have arranged for this evening a visit to the Congressional Library—not only the grandest library in the world, but I believe at the present day the grandest building in the world. We have not the richest of art to put in it. The country is too young for that. But we have a building which I believe is equal and superior to any building in the world. I went very thoroughly over the old country during the past summer, and the only thing that was anywhere in comparison is the new city hall, if I may so call it, or state building, of Brussels, and that is in such an unfinished state that its beauties are more left to the imagination than what really now exists, although the beginning is on a very large scale. In this meeting to-night I hope that we will all meet here promptly at 8.15, in the parlors of the hotel, just across the hall, so that we can visit there in a body. We will have a guide at the library, who will show us probably more points of interest than we would observe if we were alone.

To-morrow afternoon, at one o'clock, we must start very promptly. We should leave here fifteen minutes before one, and go in a body, just across the street, and take the electric cars to Alexandria. There a buffet lunch will be served, and we will visit Christ Church, and the old and quaint churchyard that surrounds it. We will then take the cars to Mount Vernon, and have ample time to visit the house and grounds, and return by the way of Arlington, having time to visit the graves of the nation's dead, and return to Washington about 6.15.

And on Wednesday—it has been somewhat difficult to time the scientific papers, and without attempting to crowd or hurry them in any way—we hope to be able to leave the hotel promptly at one o'clock, visit the United States Treasury, and then leave there and go to the White House. We are expected to be there promptly at three o'clock; and after the visit to the President of the United States we hope to have time to visit the United States Capitol. I have found it necessary to provide tickets for the White House and tickets for the Mt. Vernon Excursion, and these I will distribute to the members of the association and to the friends whom they have with them. They are not for general distribution, by any means, but only for the members and their accompanying friends. I do hope that your stay in Washington will be pleasant. It will surely be as pleasant as the committee can make it.

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The President's Address was read by Dr. G. Betton Massey.

On motion of Dr. Robert Newman, of New York, seconded by Dr. G. Betton Massey, the President's Address was referred to the Executive Council for consideration of the recommendations contained therein, to report as soon as practicable.

The attention of the Fellows and Visitors was directed to the Exhibition of apparatus in Willard Hall.

Papers were then read as follows:—

"Power of X-rays to Penetrate through Metals," by Dr. Robert Reyburn, of Washington, D. C., and illustrations, presented. Discussed by Drs. W. Scheppegrell, W. T. Bishop, W. B. Snow, and G. B. Massey. Discussion closed by Dr. Reyburn.

Dr. William T. Bishop was called to the chair during the reading of the next paper.

"A Plea for Greater Accuracy in Reporting the Treatment of Cases when the Galvanic Current is Used," by Dr. Walter H. White, of Boston, Mass., and illustrations, presented. Discussed by Drs. G. B. Massey, H. E. Waite (by permission), and W. Scheppegrell. Discussion closed by Dr. White, who then resumed the chair.

On motion of Dr. Frederick Schavoir, seconded by Dr. G. Betton Massey, the courtesies of the association were tendered visiting medical men and the privileges of discussion extended to them.

"Electricity in Respiratory and Cardiac Failure, with a Case of Paralysis of the Diaphragm," by Dr. A. D. Rockwell, of New York. Discussed by Drs. Robert Newman, G. Betton Massey, W. B. Snow, and W. Scheppegrell. Discussion closed by Dr. Rockwell.

The association adjourned at 1 P.M.

Afternoon Session.—The association was called to order by the chairman (Vice-President White) at 2.30 P.M.

On motion of Dr. William T. Bishop, seconded by Dr. G. Betton Massey, it was resolved that any paper not ready for presentation when called for should be postponed until the list was exhausted.

The following papers were read:—

"Electrotherapy," by Dr. W. S. Watson, of Fishkill-on-the-Hudson.

"Hypertrophy of the Prostate," by Dr. Robert Newman, of New York, N. Y., and instruments, presented. Discussed by Drs. W. Scheppegrell, W. H. White, W. B. Snow, and C. F. Osman. Discussion closed by Dr. Newman.

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"Currents of Large Ampèrage in Medicine," by Dr. R. J. Nunn, of Savannah, Ga. Discussed by Drs. H. E. Waite and G. B. Massey. Discussion closed by Dr. Nunn.

"Contribution to the Study of Metallic Electrolysis," by Dr. Margaret A. Cleaves, of New York, N. Y.

"The New Application of High-Frequency Currents," by Dr. Georges Apostoli, of Paris, France; read by Dr. Frederick Schavoir, of Stamford, Conn. Discussed by Drs. H. E. Waite, G. B. Massey, and W. B. Snow. Discussion closed by Dr. Schavoir.

"Rheumatism," by Dr. Charles O. Files, of Portland, Me. Discussed by Dr. G. B. Massey.

"Some Thoughts on Old Crookes Tubes," by Dr. E. A. Corson, of Savannah, Ga.; read by Dr. R. G. Nunn, of Savannah, Ga.

"Sciatica," by Dr. Charles R. Dickson, of Toronto, Canada. Discussed by Drs. Margaret A. Cleaves, C. F. Osman, W. B. Snow, G. B. Massey, and R. J. Nunn. Discussion closed by Dr. Dickson.

On motion of Dr. W. Scheppegrell, it was resolved that the papers of members present shall be given precedence and read first; that other communications be read by title, and their reading and discussion deferred to the end of the session.

The association then adjourned.

SECOND DAY—Wednesday, September 20th.

Morning—Executive Session.—The association was called to order by Vice-President White.

The secretary announced that letters had been received from the following cities inviting the association to hold its next meeting therein: Niagara Falls, N. Y., mayor and State Park Commissioners; Saratoga, N. Y.; Detroit, Mich., Governor of Michigan, mayor, Convention and Businessmen's League; Cincinnati, O., C. League; Omaha, Neb., Greater America Exposition; Milwaukee, Citizens' Business League; Cleveland, O., Businessmen's Convention League; all of which letters would be turned over to the Committee on Nominations.

The Executive Council reported that it had considered the application and would recommend for election Dr. Laura M. Reville, of Washington, D. C. On motion of Dr. Robert Newman, seconded by Dr. William T. Bishop, the secretary was instructed to cast the ballot of the association for the election of Dr. L. M. Reville, which being done, she was declared duly elected a Fellow of the Association.

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Election of Committee on Nominations. Nominations for the committee being called for, Dr. William T. Bishop was nominated by Dr. Robert Newman, seconded by Dr. W. Scheppegrell; Dr. Charles O. Files was nominated by Dr. G. B. Massey, seconded by Dr. F. Schavoir; Dr. G. B. Massey was nominated by Dr. W. B. Snow. No other nominations having been received, the chairman declared the nominations closed. On motion the secretary was instructed to cast the ballot of the association for Drs. Bishop, Files, and Massey, which being done, they were declared duly elected members of the Committee on Nominations. The chairman read Paragraph No. 26 relating to the duties of the committee, which was instructed to report at 8 P.M. at the Business Meeting.

The vice-president appointed Drs. Frederick Schavoir and W. B. Snow a Committee on Audit to examine the books and vouchers of the secretary and treasurer, and to report at 8 P.M. at the Business Meeting.

The Executive Session then adjourned.

General Session.—The association then went into General Session.

The following papers were read:—

"Case of Radiography of Stomach, Bladder," etc., by Dr. Fouveau de Courmelles, Paris, France. Read by Dr. Frederick Schavoir, of Stamford, Conn. Discussed by Dr. J. D. Gibson.

"Modalities of Induction Currents," by Dr. William J. Herdman, of Ann Arbor, Mich. Read by title.

"Osmosis and Bielectrolysis," by Dr. Fouveau de Courmelles, of Paris, France. Read by title.

"Treatment of Tubercular Glands of the Neck without Scar," by Dr. G. Betton Massey, of Philadelphia, Pa. Discussed by Drs. R. Newman, R. J. Nunn, W. T. Bishop, W. Scheppegrell, and M. A. Cleaves. Discussion closed by Dr. Massey.

"Electricity in the Treatment of Dilatation of the Stomach," by Dr. John A. Lichty, of Pittsburgh, Pa.; read by Dr. A. D. Rockwell, of New York, N. Y. Discussed by Drs. G. B. Massey, W. Scheppegrell, R. J. Nunn, M. A. Cleaves, and W. B. Snow. Discussion closed by Dr. Rockwell.

"Light as a Therapeutic Agent," by Dr. J. H. Kellogg, of Battle Creek, Mich., and illustrations, presented. Discussed by Drs. H. E. Waite and W. S. Watson.

The association adjourned at 12 M.

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Evening Session—Business Meeting.—The association was called to order by the chairman (Vice-President White) at 8 P.M.

The report of the Committee on Audit was read by Dr. Frederick Schavoir.

On motion of Dr. William T. Bishop the report was accepted.

The report of the secretary was read by Dr. C. R. Dickson.

On motion of Dr. William T. Bishop, seconded by Dr. W. Scheppegrell, the report of the secretary was accepted.

On motion of Dr. Elihu B. Silvers, the association expressed its deep sympathy with the family of the late Dr. Caleb Brown, and directed that an engrossed copy be sent to his family. Dr. W. B. Snow spoke to the motion.

The report of the treasurer was presented by Dr. R. J. Nunn, who directed the attention of the association to the large expenditure incurred on account of the last meeting. Dr. C. R. Dickson acknowledged that the expenses during his presidency had been very heavy, but thought that results had justified the seeming extravagance.

On motion the report was accepted.

The report of the Committee on Nominations was presented by Dr. William T. Bishop, as follows: Your committee beg to submit the following names for election to the respective offices for the following year:—

President, Dr. Walter H. White, of Boston, Mass.

First Vice-President, Dr. D. Percy Hickling, of Washington, D. C.

Second Vice-President, Dr. Charles O. Files, of Portland, Me.

Treasurer, Dr. R. J. Nunn, of Savannah, Ga.

Secretary, Dr. George E. Bill, of Harrisburg, Pa.

Members of Executive Council, to retire in 1902: Dr. Charles R. Dickson, of Toronto, Canada. Dr. Frederick Schavoir, of Stamford, Conn.

Dr. W. T. Bishop, having taken the chair, on motion of Dr. William B. Snow the report was adopted, and the secretary was directed to cast the ballot of the association for the election of the candidates for the offices named, and they were declared elected unanimously.

Dr. William T. Bishop further reported that, for place of meeting, the choice lay between New York and Niagara Falls.

On motion of Dr. Elihu B. Silvers, seconded by Dr. Frederick Schavoir, New York City was selected as the next place of meeting, Dr. William B. Snow and Dr. D. Percy Hickling speaking to the motion.

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On motion of Dr. Elihu B. Silvers, seconded by Dr. William B. Snow, the association voted to meet on September 25, 26, and 27, 1900.

Dr. Charles R. Dickson presented the following Supplementary Report from the Executive Council: Your council beg to report that it has considered the recommendations contained in the President's Address, and would advise that the following words be struck out of Article 9 of constitution, relating to applications for membership, namely: "two months before the first day of the annual meeting."

The name of Dr. J. D. Gibson, of Birmingham, Ala., is recommended for election as Fellow.

On motion of Dr. William T. Bishop the report was approved.

On motion of Dr. William T. Bishop, seconded by Dr. William B. Snow, the secretary was directed to cast the ballot of the association for the election of Dr. J. D. Gibson, which being done, he was declared duly elected a Fellow of the Association.

On motion of Dr. Elihu B. Silvers, seconded by Dr. D. Percy Hickling, the Executive Council was instructed to take into consideration the proposal to present a form of certificate of membership, and to inquire into the expense of same.

Notices of Motion.—Dr. Charles R. Dickson gave notice of motion to amend constitution, Article 9, relating to applications for membership, by striking out the words, "two months before the first day of the annual meeting."

Dr. D. Percy Hickling gave notice of motion to amend the by-laws by striking out By-law No. 29, relating to the holding of an exhibition of instruments and apparatus.

Dr. Robert Newman gave notice of motion to amend the by-laws by adding the following: "Candidates for membership must qualify within two months of their election or forfeit their membership."

On motion of Dr. G. Betton Massey, seconded by Dr. William B. Snow, it was resolved that the actual expenses of the secretary at the meeting be paid by the association.

On motion of Dr. Frederick Schavoir, seconded by Dr. William B. Snow, the Executive Council was directed to request medical societies to send delegates to the next meeting of the association, and also to appoint delegates from this association to other associations.

Dr. D. Percy Hickling reported that a Society of Electro-Therapeutics had recently been formed in Italy. On motion of Dr. Hickling the American Electro-Therapeutic Association was directed to send greetings to the Italian Association, through the secretary.

The association then adjourned.

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ADDRESS OF THE PRESIDENT.

FRANCIS B. BISHOP, M.D.

Ladies and Gentlemen, and Fellow-members of the American Electro-Therapeutic Association: Once in every little while one hears a wail and cry at the loss of the "old-time family physician," and at the rapid growth of special branches in the healing art. Our old-time physician was, at once, our physician, surgeon, nurse, and apothecary; often our friend and adviser, and always a welcome visitor in sickness or in health. We would not depreciate him if we could, nor could we, if we would; ever faithful, ever true, he lives to-day in all his glory, and will exist to the end of time. It is true he has changed, for in his pursuit of a general knowledge of disease he finds himself consulting works on special branches, written by men who have devoted their lives to the study of special diseases and special apparatus. He no longer calls a case of appendicitis "typhlitis" or "perityphlitis" and allow his patient to linger and slowly die of pyæmia, but he calls a surgeon, because of his special studies in this disease, as well as his well-known skill in manipulating the knife, the use of antiseptics, and his knowledge of regional anatomy, and he feels that his patient has a better chance for his life and restoration to health in the hands of an acknowledged expert. He knows no selfishness, he is thinking only of the welfare of his patient, and I have known the country practitioner to lose many days and travel many miles with a patient, at considerable personal loss, to consult an expert. The oculist, the neurologist, the analytical chemist are all consulted in their turns, in order that the etiology, pathology, and treatment of disease may be considered from the highest stand-point of science.

Why does "our old family physician" no longer treat all the diseases that fall to his care?—those of the eyes, the nose, the lungs, etc.? Is it because he is retrograding? No, I say emphatically, no! There never was a period in the history of man which has produced more skilled and scientific physicians than the present. It is because of their progress and the progress that has been made in the study of disease that renders special study upon special branches necessary. The skill of the general practitioner to-day renders him able to detect, very early, a condition calling for special treatment, and enables him to call to his assistance the expert, often while it is yet time to save life and

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restore the patient to health. It is impossible for any man to make himself proficient in all the branches of medicine of to-day, as it requires all the time, energy, and application of an ordinary man to master one branch and attend to it as he should.

As we all know, for many years, the use of electricity, as applied to disease, was largely in the hands of quacks and charlatans, but a few legitimate physicians had the courage to carefully study this agent as scientifically applied to the cure of disease, and to put the result of these observations and study into practice, amid the jeers and sneers of the professional world. Gradually these pioneers gathered recruits and ultimately formed themselves into a scientific body for "The cultivation and promotion of knowledge in whatever relates to the application of electricity in medicine and surgery." This was the nucleus of our honored association, and while we are, as a body, only nine years old, already sister-electro-therapeutic associations are being formed in France and in other countries across the water, and, if the founders of this association have no other monument, this association, at least, I hope, will remain a living testimonial to their worth and their effects in behalf of human kind. This may be accomplished by continually increasing the working efficiency of the association, and this can be done only by requiring applicants for membership to show reason why their applications should be considered, by furnishing a thesis on electro-therapeutics and presenting it with their applications to the executive council. This clause did exist in our constitution, but instead of being enforced, has been left out in the revision. It is to be hoped that this matter will enlist the sincere consideration of the association, for I earnestly believe that if we wish to increase our membership with good, working scientists, it can only be done by making it an object to become a member, and those who aspire to membership will work and study until they can furnish the requirements. It is not right that we should consider applications for membership from those who are not qualified to prepare a thesis. The quotation, "By their works ye shall know them," applies to this association, and is just as true to-day as it was hundreds of years ago. The eyes of the world are upon us, and we should endeavor to let our lights so shine that they may see our good works. At a meeting of the executive council in New York on May 29th, last, a committee was appointed to "Present and urge to the American Confederation of Medical Examiners the importance of adding to the college-curriculum the subject of electro-therapeutics." It is hardly fair to assume that we will be able to elicit

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the consideration of these gentlemen if we do not maintain a high standard of required efficiency by restoring to our constitution, and enforcing, the clause which must, at once, give us strength, and command the respect of the scientific world.

Electrotherapy is not a simple subject, nor one to be treated lightly. It is a progressive science, and demands the sincere consideration and undivided attention of those who wish to make a success in its practice; therefore, the electro-therapeutist becomes a specialist, and, in consequence of the great variety of disease that will come under his care, it is decidedly better that the electro-therapeutic specialist should have been a general practitioner of some years' experience, as this experience will enable him to recognize complications and to give them the required medical treatment. A great many cases come under his care which have been treated in a variety of ways and by many methods, and, not infrequently, electricity has been used by some physician, thoroughly qualified in other respects, but inexperienced and incompetent to use electricity to the best advantage. Hence, by the injudicious use of this potent agent, the inexperienced physician often does infinite harm instead of doing good.

When we consider the variety of diseases and conditions which the electro-therapeutist must treat, and the varied stages of the same disease requiring different methods of treatment, the demand that he know his apparatus and the currents they produce, and how to vary them to suit special conditions, becomes imperative.

He should understand his static machine,—how to take it to pieces and replace each part, how to keep it clean and how to keep it charged; he should know, as far as possible, the therapeutic value of the separate poles; how to get the soothing, the tonic, and the stimulant effects of the convective discharge; how is the best and most agreeable way to get the "Morton Static Induced Current," and, above all, to know when the spark should be used, and in what degree. He should know when the ozone-bath is indicated, and the best method of obtaining it; how to use the unidirectional high-tension static current and to know the cases requiring it. These, and many facts besides that are necessary, can only come by constant practice and close application to the study of the subject of static machines.

What is true of static electricity is true also of the direct current, the induction-coil, the sinusoidal machine, the high-frequency apparatus, and the alternating dynamo currents, of high and low voltage.

A working knowledge of volts, ampères, joules, watts, ohms, cou-

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lombs, etc., should be within the knowledge of every electro-therapeutic specialist.

He should know how to diagnose a case of multiple neuritis without testing the motor points for reaction of degeneration, and he should not treat a case of wasting of the limbs, with complete or partial paralysis, until he is sure of his diagnosis. Neuritis and poliomyelitis often produce conditions similar, and are to be treated very differently. What will cure the one might render the other incurable. A sciatica or other neuralgia must be very carefully examined before treatment to determine whether it be a neuritis, rheumatism, or due to some local pressure, or is simply a reflex manifestation of some other existing disease. He should know when, and in what manner, to treat a uterine fibroid in order to do the most good and the least harm, and he should also know what cases he should not treat at all. Ovarian neuralgias are often easily cured by the proper method of electrical treatment, but pus-tubes should be carefully avoided with any current which would produce the slightest contraction, and, in my opinion, they are cases entirely for the surgeon, especially if the case is well developed. He should know that, where the induction-coil is indicated, the direct current will often not take its place, and that a stricture cannot be dissolved by the interrupted current, and can only be treated successfully by the most patient care of the operator with the proper instruments, and that the "*tactus eruditus*" is nowhere more required than in the treatment of organic stricture by electrolysis.

These are only a few of the important requirements of the electro-therapeutic specialist. He is called to treat from the mildest to the most profound functional nervous troubles, and the most intense organic lesions are sent to him for treatment. He should know how to discriminate and be careful in his prognosis. If he treats a serious case lightly, he is bound to suffer in the end, and, if he gives an unfavorable prognosis in a functional or curable case, he runs the risk of causing the patient and friends to suffer untold mental agony, if, indeed, he does not render the case entirely hopeless.

These and many more reasons which you, fellows of this association, already well know should place the skilled electro-therapeutist in the front rank of specialists, and, because of our study and practice in this special branch, we become the ally of the general practitioner; his interests are our interests, and it is our duty to do all in our power for his patients when they are sent to us, and, at the same time, to guard carefully the honor and professional standing and interests of our

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brother, so that he may feel, when his patients have been intrusted to our care, that they will return to him when in need of general attention, for, as you, no doubt, already know, it is a common experience with specialists to have those whom they have benefited to plead for attention from this specialist for all causes and complaints, because the patient imagines that, as we have cured a malady which others have failed to cure, our skill must, of necessity, be greater in all other diseases. We should be big enough to disabuse their minds.

The general practitioner, in sending patients to the electro-therapeutic specialist for treatment, often injures his case and ties the hands of the specialist, by sending them with restrictions, often telling them they ought to experience much improvement in a week or a month, when the patient is suffering from a disease that different doctors have been working on for years without the slightest benefit; then the electro-therapeutic specialist should be given unlimited scope in completing diagnoses, and having made urinalyses, microscopical examinations, and, in fact, do all in his power to place himself in the right position to do the best he can for the patient, and, when, in his judgment, it is required, he should have the privilege of prescribing the medicine needed in that particular case. I have had patients come to me and tell me that their physicians thought that a few *shocks* of electricity might do them good; now, we all know, and the papers that are read before this association annually prove conclusively, that many chronic diseases that have failed to respond to other methods of treatment, have yielded to electrical treatment, only, however, when properly applied, and, often, many months of treatment are necessary before we get the slightest sign of improvement, and yet the case may be, and often is, susceptible of great improvement and sometimes cure, by persistent, careful treatment.

The medical colleges are slow to recognize the importance of this branch, and of dignifying their faculty by making a chair on electro-therapeutics. Some of the advanced colleges have done so, and it seems reasonable to conclude that, if a school of medicine wishes to be considered first class, it must teach this branch, and teach it well. The students will, in time, demand it, for the time is not far distant when the student will realize that the college which does not include an honest teaching of electro-therapeutics in its curriculum is not giving a proper education, and is leaving its alumni far behind their competitors from other schools of medicine where this branch is taught, and I believe it to be the duty of each member of this association to

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influence the students of medicine under his care, to attend only colleges fully equipped with apparatus, and furnishing a chair on electro-therapeutics filled by a thoroughly competent professor. In the present state of electro-therapeutic knowledge, I do not believe any self-respecting electro-therapeutist would be willing to accept a minor position on a college faculty, but that he would demand a title and a position equal to those of his fellow-teachers.

I now beg permission to call attention to paragraph 9 of our constitution, which, in my opinion, should be amended so as to read: "Every applicant for membership, whether as Fellow, Life-fellow, Honorary Fellow, or Associate Fellow, shall be indorsed by two fellows in good standing, and be presented to the Executive Council, through the secretary, in time to receive the consideration of the Executive Council prior to the annual meeting of the association. And every applicant for membership shall present a thesis to the Executive Council as an evidence of his qualification for membership, and, when recommended by the Executive Council, shall be voted upon by ballot at the annual meeting; a list of the recommended names shall be sent to every member with notification of the meeting; the nomination of Honorary Fellows shall be vested in the Executive Council."

As the paragraph now stands, no candidate can be considered by the Executive Council later than two months prior to the first day of the annual meeting, preventing many good workers from becoming members at this time.

And now, fellow-members of the American Electro-Therapeutic Association, it becomes my sad duty to remind you that since our last meeting, one short year ago, "the angel of death has sought and taken one of our esteemed members, a man universally beloved for his kindness of heart, and universally respected for his dignity of bearing and his keen mental grasp. Dr. Caleb Brown, of Sac City, Iowa, was born January 27, 1850, in Knox County, Ohio, and died, after five weeks' illness, June 4, 1899. He graduated in the classical department from the Iowa State University, and received his degree in medicine in 1877 from the College of Physicians and Surgeons, Keokuk, Iowa. For two years, beginning September, 1892, he held the chair of Chemistry, Toxicology, and Microscopy in that college, but resigned the position because of its interference with his other professional work. He was a member of the local medical society (the Northwestern), of the Iowa State Medical Society, the American Medical Association, and the International Association of Railway Surgeons," and in 1894 he was

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elected a fellow of this association, and, from September, 1897, to September, 1898, he was second vice-president. We mourn the loss of our brother, and we mingle our sorrow with that of his loved ones at home.

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REPORT OF THE CHAIRMAN OF THE STANDING COMMITTEE ON DIRECT-CURRENT GENERATORS AND CONTROLLERS.

No very notable additions have been made during the past year to the apparatus designed either to generate or control direct currents for electro-therapeutic purposes.

As stated in my last annual report, the advantages which the dry cell possesses over the liquid cell, especially for batteries employed in portable work, has increased the demand for batteries supplied with dry cells. The tests which I began a year ago in the Electro-Therapeutic Laboratory of the University of Michigan upon the efficiency of various forms of dry cells for electro-therapeutic work are still in progress and will not be completed for a year from this time. I may say, however, that the results obtained thus far will justify the hope that the dry cell will, in time, become a very satisfactory substitute for the fluid cell for both the stationary and portable batteries required by physicians.

There is a growing inclination on the part of physicians, surgeons, and dentists to discard the use of primary and secondary batteries as a source of current in favor of the use of industrial currents whenever it is possible to get access to them. Apparatus designed to make this source of current safe and to conveniently control such currents for electro-therapeutic uses have, therefore, claimed the attention of manufacturers more and more.

The direct electric current possesses a wider range of therapeutic usefulness than any other form of electric modality. Aside from its capacity to cause contraction of muscle and to excite the characteristic response in both motor and sensory nerves, it causes electrolysis and phoresis, which are powerful therapeutic resources, useful in a great variety of disorders both medical and surgical in nature. It is moreover a valuable means for diagnosis, and in many instances indispensable for determining the true state of nutrition of nerves and muscles.

But the use of the direct current by physicians and surgeons has been much retarded because of the difficulties that have always attended the generation and control of it. There are many objections to primary batteries of whatever kind; they require such constant care

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and attention to keep them in an efficient working state. Secondary batteries are even more troublesome and expensive. Dynamo circuits are a convenient source for the direct current to those favorably situated, but they are of such varieties of voltage that the controllers so far designed for one circuit are useless on one of different voltage.

It has long been evident that greater uniformity, simplicity, and efficiency in the appliances for using the direct current in therapeutics must be brought about before it will be very generally employed. The requisites in a direct-current apparatus for therapeutic purposes are:—

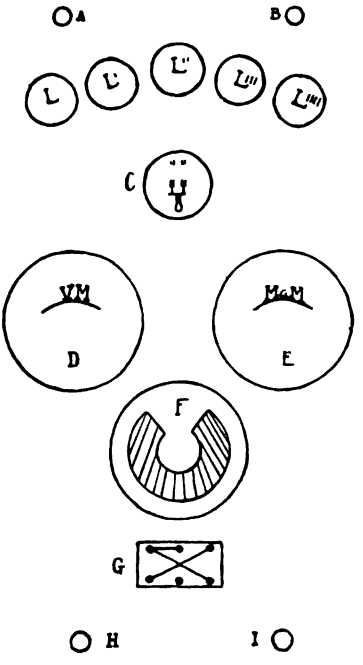

Fig. 1.

(*a*) A wide range of current-capacity.

(*b*) Safety to the patient.

(*c*) A ready and convenient means for varying the strength of the current.

(*d*) Exact and instantaneous measurement of the electromotive force and ampèrage of the current traversing the patient.

(*e*) Means for changing the direction of the current without disturbing the electrodes when they are in position on the patient.

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I have recently, by an arrangement of apparatus for use of the direct current in my laboratory work, been able to meet all of these requirements in a very satisfactory manner, and am now about to adopt the same arrangement in my hospital work.

The accompanying diagram illustrates the apparatus employed to accomplish this end and the manner of its arrangement.

A and *B* are binding-posts for the wires connecting the instrument with the source of direct current, which may be primary batteries, secondary batteries, or a dynamo circuit of 110, 220, or 500 volts.

C is the cut-out, or switch, by turning which the current is admitted or shut out from the board.

F is a graphite rheostat connected *in series* in the main circuit and *in shunt* for the patient's circuit.

D and *E* are voltmeter and milliampèremeter, respectively, so connected as to give the reading of electromotive force and current on the *patient's circuit,* no matter in which direction the current is traveling.

G is a pole-changer, which indicates also the direction of the current.

H and *I* are the binding-posts for the connections to the electrodes; or, in other words, the binding-posts for the patient's circuit.

L, *L'*, *L''*, *L'''*, *L''''* are lamps, or places for lamps, to be used if needed when the source of current is such as to require more or less resistance to modify it for electro-therapeutic use.

Suppose, now, we have for a source of current 50 or 70 Leclanché cells. The voltage of these will be 1.4 per cell, or, when coupled in series, from 70 to 100 volts for the series.

None of the lamps need to be used in this case, but the connections may be made directly from the binding-posts to the switch and the graphite rheostat. The direct resistance of the rheostat is 10,000 ohms; so that when the switch is closed and the battery of cells is delivering its current through the rheostat the resistance in the circuit is high enough to prevent a short circuit and a rapid waste in the cells. The resistance in the patient's circuit, which is in shunt with the main circuit, may be made much less than 10,000 ohms by moving the movable radius of the rheostat, which is a part of the patient's circuit, and thus the amount of current given to the patient can be varied at will.

Should the source of current be the 110-volt dynamo circuit, lamp *L''* can be connected in shunt with the rheostat, and thus divide the current with the rheostat and at the same time light the board. This is a convenient indicator for the presence of the current on the board.

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Should the source of current be the 220-volt circuit the wiring from the upper binding-posts should include lamp L'' in shunt as before, and another lamp *in series* as L'; or both lamp L' and lamp L''' could be connected in series with the rheostat and thus light the board symmetrically, provided the lamps used are but one-half the voltage of the lamp used in shunt at L''.

Should the source of current be the 500-volt circuit usually employed for trolley-cars or for supplying power, a form of dynamo that would, in most instances, be most convenient for physicians' use, then lamp L'' could still be connected in shunt with the rheostat and lamps L, L', L''', and L'''' be connected in series. This would cause a drop of potential sufficient to make a safe current and voltage for the patient's circuit.

Thus it is seen that the use of this arrangement of appliances requires only a little change in the preliminary wiring of the board for any one of the sources of current mentioned. After this is done the action of the remaining parts is the same for all. The board is thus adapted for all these and many other sources of current, and permits of uniformity in the control and measurement of direct currents for therapeutic use where formerly there was great diversity.

Uniformity in method will soon be followed in electro-therapeutic practice by uniformity in results. Comparison of results of different operators will then be possible, and the reasons of a difference in result, if it exists, can be the more readily discovered.

This arrangement for controlling direct currents possesses two other notable advantages that should be mentioned, as they are very essential to a successful direct-current technique. The shunt-rheostat of graphite of very high resistance permits of a very gradual admission of the current into the patient's circuit when it is closed for the treatment, and a very gradual withdrawal of the current when the treatment is ended. In dealing with sensitive patients this feature is one of great advantage. Then the pole-changer in the patient's circuit, which enables the operator to reverse the current in the direction through the patient without disturbing the position of the electrodes or modifying the arrangement in any other particular, is of great assistance in diagnosis, and adds much to the accuracy of the result. It is likewise very helpful in treatments by electrolysis, in which a reversal of the polarity is often needed.

A simultaneous record of the electromotive force and of the current enables the operator to determine at any moment, by the product

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of these two amounts, the number of watts that are being expended in the treatment, and the additional record of the time during which the current flows will furnish the means for determining the exact amount of energy to which the tissues have been subjected by each treatment.

Each step toward simplicity and exactness furnished by this arrangement of apparatus promotes the scientific practice of electrotherapy.

WILLIAM J. HERDMAN,

Ann Arbor, Mich., September 12, 1899. *Chairman.*

SUPPLEMENTARY REPORT OF THE STANDING COMMITTEE ON DIRECT-CURRENT GENERATORS AND CONTROLLERS.

No instruments have been sent me for examination or testing. New ideas have been watched for, correspondence has been had with several manufacturers, and even a meeting held, with no result to recommend anything in particular.

1. A new urethroscope has been manufactured by the Electro-Surgical Instrument Company, in Rochester, for examinations and treatment of the urethra, which appears to have some merits. The price is thirty dollars.

2. A new combination battery has been made by the Electro-Medical Manufacturing Company, southeast corner Fifty-ninth and Wallace Streets, Chicago. The manufacturer has written to me, sent a catalogue, but I have not seen the instrument.

3. Chemical Battery Light, Heat, and Power Company is the name of a new company, which promises to furnish a battery for the above purposes, producing light, heat, and power for less cost than any other plant in existence, and produce new useful merchandise after the battery has been exhausted. The general manager is William Horatio Day, who refused to send me a battery, for which I promised to pay, for testing.

4. Whitfield's rejoinder is a cabinet, nearly as large as a small room, using electricity as a curative agency. The inventor takes the position that, on account of the high conductivity of the blood, it would be impossible to reach the tissue, and the tissue might be the diseased part of the body. By making each atom a generator of electricity, this difficulty is overcome, and the current is equally distributed throughout every portion of the body. I have corresponded with Mr. M. L. Whitfield and also had a personal meeting with him. He

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promised to send me the cabinet for experiment, and that is the last I have heard from him. Therefore I refrain from giving any opinion.

These four appliances are mentioned only as novelties in the market, without giving any decided opinion, and the impossibility of any recommendation is obvious under the circumstances.

5. Dr. E. W. Smith, of Terre Haute, Ind., has constructed a new portable "Dynamo Electric Machine" to be used as a galvanocautery, and for the faradic and sinusoidal currents. The inventor has promised to demonstrate his machine at this meeting.

ROBERT NEWMAN, M.D.,
New York.

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POWER OF X-RAYS TO PENETRATE THROUGH METALS.

By Robert Reyburn, A.M., M.D., Washington, D. C.

Probably no development of electricity during late years has excited more general interest than the discovery of the x-rays by Professor Roentgen.

What are these x-rays, and whence do they come?

Many theories have been elaborated concerning them, but the writer is inclined to side with those who believe that these Roentgen, or x-rays, are simply the rays from the invisible part of the solar spectrum, beyond the violet end of the spectrum (and also beyond the lavender band discovered and named by Sir John Herschel).

The uses of these rays in investigating the diseases of the chest and abdomen have been greatly impeded by imperfection of the views given by the fluoroscope, during the examination of these cavities of the body.

We believe, however, that we are only on the threshold of these investigations, and think that in the near future the uses of these wonderful rays will be manifold, and that they will be applied in many ways now unthought of. While it is easy to see distinctly the skeleton, such as the ribs, spinal column, etc., yet the differentiation of the softer tissues of the body has generally been found to be unsatisfactory.

Improvements in the brilliancy of these shadow-pictures have enabled us to map out tubercular deposits in the lungs, and the stomach has been well outlined by one experimenter, who gave subnitrate of bismuth internally, and, after allowing it to diffuse itself over the inside coating of the wall of the stomach, an excellent picture is said to have been obtained.

The subnitrate of bismuth has three excellent properties which render it peculiarly well adapted for such experiments: 1. It is insoluble or nearly so in the fluids of the body. 2. It is nearly opaque to the Roentgen rays. 3. It is non-poisonous, and can thus be safely experimented with.

It is to be hoped that further experiments with this and other bodies which possess analogous properties may give us still clearer and brighter pictures, not only of the stomach, but also of other organs of the body.

Platinocyanide of barium and tungstate of calcium have been almost exclusively used for coating over the inner surface of the fluoroscopes.

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Yet it cannot be that the property of rendering these images more visible to the human eye is possessed by these salts exclusively, and further experimentation with other chemical compounds may, and probably will, give us Roentgen pictures far excelling those we now possess.

In looking over any treatise on the Roentgen rays we usually find a long list of bodies which are said to be opaque to them, and among these are classed some of the metals. It should be remembered, however, that such lists are only comparative; in fact, it is the opinion of the writer that all bodies are permeable to these Roentgen rays in some measure, and it is only a question of the greater or lesser degree of transmittal.

Take, as an illustration of our meaning, the transmission of ordinary light through window-glass. Glass is usually and correctly said to be transparent to light, and yet each pane of glass obstructs, in some degree, the amount of light entering the room, and we might superimpose one pane of glass over another until the amount of light entering the room would be so greatly diminished that the room would become comparatively dark. Copper, for instance, is said to be opaque to the x-rays; yet it will soon be seen that the writer has succeeded in producing radiographs, or sciagraphs, through copper electrotype-plates.

The writer has made a number of experiments with the Roentgen rays, and has recently discovered what he believes to be a new method of utilizing them which he will now describe.

On February 20, 1897, a number of objects (mostly metallic) were placed in position for the purpose of taking radiographs. It may be necessary to explain, to those who are not familiar with the process of taking these pictures, that they are taken without any exposure to ordinary light, and that no camera, lens, or other optical instrument is used in their making.

The photographic plates are wrapped in two thicknesses of black paper, and are placed under the Crookes tube in such a position that the x-rays emanating from the tube will strike upon them. The objects to be copied are placed directly upon the top of the black-paper-covered plates, and, on the Crookes tube being connected with the electrical apparatus for a proper length of time, the pictures are produced.

The apparatus used in the making of these pictures was not the Ruhmkorff induction-coil connected with a storage battery, but con-

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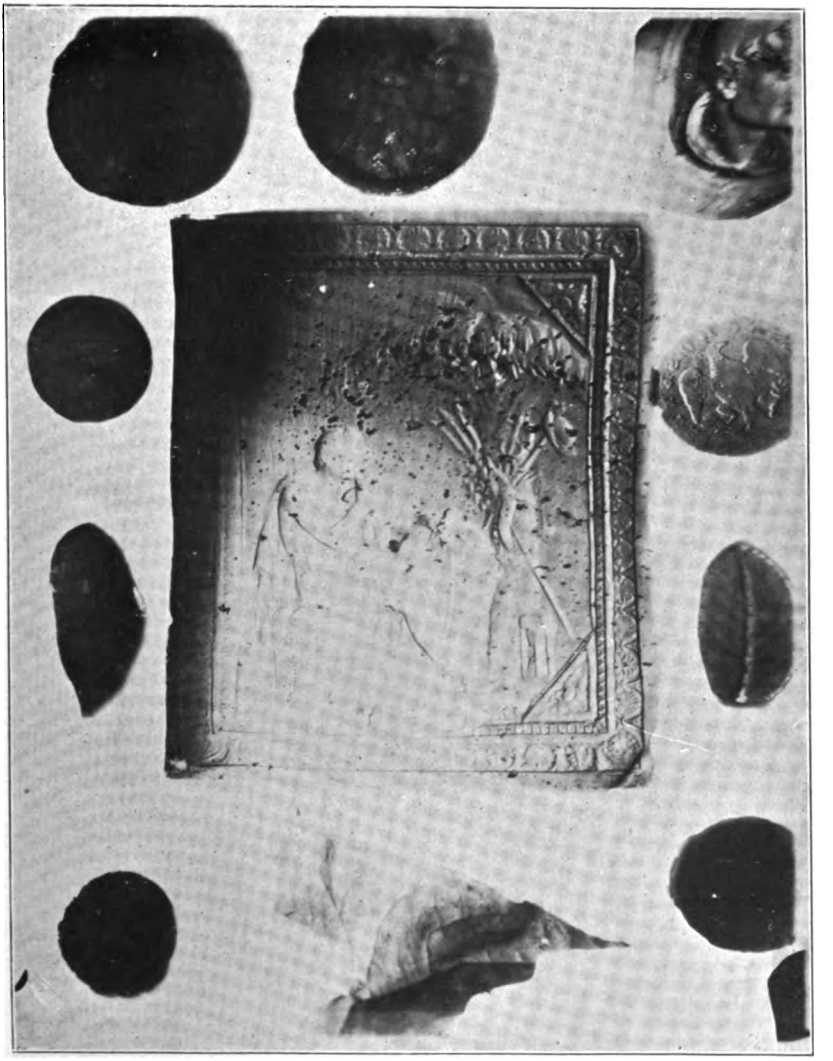
PLATE I.



Radiographs of Metallic Objects, showing Penetration of Thin Sheets of Electrotype Metal by X-rays.

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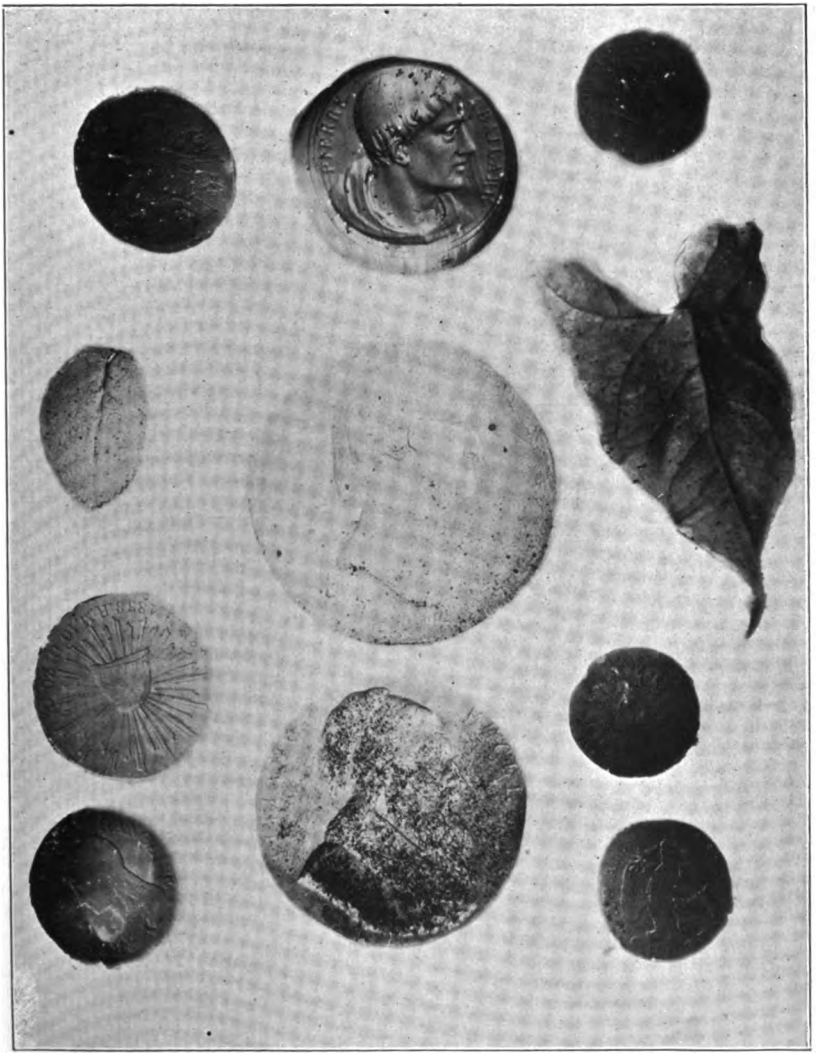
PLATE II.



Radiographs of Metallic Objects, showing Penetration of Thin Sheets of Electrotype Metal by X-rays.

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sisted of a large Toepler-Holtz induction machine made by Waite & Bartlett. This machine has six twenty-six-inch circular glass plates, and gives, when in good action, a spark, or electric discharge between the two poles, of from eight to ten inches. A very great improvement has recently been introduced in the addition to these machines of circular condensers, which equalize the flow of electricity between the positive and negative poles of the electrical machine, and cause the x-rays (which are known by the greenish light which fills the tube) to become steady and uniform.

As above mentioned, a number of metallic objects were placed upon suitably wrapped photographic plates for the purpose of taking a radiograph picture of them. They were exposed to the x-rays for fifteen minutes, and were placed about three and one-half inches distant from the Crookes tube. Among these metallic bodies was an electrotype copy of a coin. To my surprise on developing the photographic plate, I found that the design upon the coin had, as it were, been driven through by the x-rays, and had been impressed upon the paper-covered plates; while the other objects had only been copied in outline. This at once showed that it would be quite possible to copy engraved plates of any kind, metal medallions, etc., by means of the x-rays.

Further investigations have confirmed this opinion, and the accompanying photographs show, in some degree, what can be done, and we think will confirm the truth of the statements made in this paper.

What are the requisites for success in making these pictures?

The first of these is that the plates of metal containing the design to be copied shall be thin.

Curiously enough I had on hand quite a number of copies of coins and medallions made by the process of electrotype many years ago. These are of thin copper about twice the thickness of writing-paper (say $^1/_{30}$ to $^1/_{40}$ of an inch in thickness) and are just right for our present purpose, and copy very well.

It is quite possible, however, I have found, to copy through thicker metal plates than mentioned above, but it entails an inconvenient length of time of exposure. If the time be increased sufficiently, I believe it would be possible for the x-rays to penetrate through metallic plates of almost any thickness.

The question will, no doubt, be asked by many *cui bono*—of what practical use is this discovery? Now, while it is perfectly true that it does not seem at present to be possible to copy engraved metallic

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plates, etc., cheap enough to make this process a commercial success, yet we cannot tell what may develop in the future.

When it was first discovered that, during the action of a galvanic battery, the copper deposited would perfectly copy any conducting surface on which it was deposited, no one imagined that this little discovery would branch out into an industry that employed thousands of workmen, and necessitate the investment of millions of capital.

So perhaps it may be with the discovery that the x-rays discovered by Professor Roentgen have the power of penetrating sheets of metal and impressing the designs engraved upon them upon photographic plates.

DISCUSSION.

DR. SCHEPPEGRELL: As I understand the matter, there is really no metal that is absolutely opaque to the action of the x-rays. The opacity is only relative, and that it is so is proved by the doctor's pictures. He has been successful with these thin plates. If he can obtain such results in plates a thirty-second of an inch thick, thirty-two times the exposure ought to give almost the same result in an inch plate. Now, the interesting part, as I view it, of these sciagraphs is the outlines of the photographs. That is a little more difficult to understand than the penetrating power of the rays. One part of it I can understand,—that where these figures are imposed, it makes an angle, and, therefore, when the rays strike through, they strike at an angle. It makes that part relatively thicker than the neighboring parts, and brings out the outline of that expanse. In some places where there is a dark line it brings out the figures imperfectly. But still it is definitely a new field, and I am very much pleased with these sciagraphs.

DR. W. T. BISHOP: It looks to me, Mr. President, as though this discovery has a commercial value,—one of very great importance. Medals have been found of which it is impossible to get copies because an electrotype or any other system of copying injures the finer lines. This would allow copies to be made without injury. So it seems to me as though it has a value of commercial importance. It is very possible, also, that it might be used to detect fictitious medals that are sold at high prices,—medals that have been tampered with. For instance, if one of our cents were so altered as to make it 1801 instead of 1901 the fraud could be easily detected. It looks as though this method of copying these plates would be of immense value, not only as a commercial thing, and in scientific investigation, but in verifying historical objects.

DR. SNOW: Mr. President, it seems to me that in penetrating metals we are getting further away from our possibilities of making use of it therapeutically, because there is where our trouble comes. We cannot photograph what we penetrate; and the gentleman in his paper suggested that he was hopeful that the scope in medicine was being broadened, but in our work we are finding constantly that the tendency and power of the rays is to penetrate, instead of giving us the possibilities of photographing shadows of the invisible, which we wish to see so often, besides the bones. And, of course, in this discussion, if there can be some suggestions made by which we can better photo-

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graph the soft tissues, that would be an approach to a field which would be more valuable to us as medical men than this new suggestion, as a scientific discovery.

DR. MASSEY: It seems to me that the answer to these remarks would be that we must develop in delicacy as well as in power, and the depth of the penetration would probably lessen the usefulness of the machine for depicting the soft tissues.

There are two thoughts suggested by this paper to my mind. The penetration of the actinic rays of light is a question that will be useful to us as physicians. If we get this actinic power from these artificially generated rays by means of the tube, how important it is that we should fully realize the actinic power of sunlight, even when penetrating clothing, as a means of conserving health. It is a stimulus to us to prescribe more sunbaths to our patients, and also to make use of the artificially-concentrated light-baths, as doubtless will be discussed at some time in this session. The other thought that occurred to me may be worth noting. It is on a broader plane of physical world-history. If the actinic rays of light are capable of penetrating metals or dense world-bodies, possibly that might refer the oxidation of the world's crust at varying depths gradually to the actinic power of the sun, without having assumed that we have had any other special oxidizing force on the earth's surface. For if these artificial creations can produce rays that will penetrate metal of considerable thickness, what must be the effect of the actinic power of sunlight itself, shining on the earth's surface through untold ages?

DR. WILLIAM T. BISHOP: There is another thing that strikes me, from an academic stand-point. The gentleman seemed to think this had no value except a commercial one. The ray has been destructive of theories. For instance, it has been claimed that it would cause burns, etc. Why can't those parts be protected? If you wanted to destroy a particular part, why can't you protect the rest? It seems to me it does not matter in what way you find out a truth, if that truth is valuable to the world, whether it is valuable to us as physicians or not. It would look as though, with some proper coating, you could protect certain parts, just the same as in the case of these pictures.

DR. SNOW: I want to say that I do not wish to go on record as criticizing the gentleman's remarks, but I only spoke with a view to calling out an important point which appealed to me.

DR. REYBURN: Could we not spray safely within certain cavities some soluble substance that would form an opaque deposit that would make them visible by means of the rays? Would it be possible to spray a weak solution of prussiate of potash, which, you know, after awhile would cover a great portion of the lungs, and a solution of iron, that would precipitate? Of course, we must carefully avoid injury to our patients, but, with this limitation, I am considering whether it would be possible to do this, and to get a better picture. It has been shown, I believe, that we could do a good deal with bismuth. If we could get a substance like bismuth that would be soluble, and could make a solution, it would be valuable. It is rather a new thing to me, and, so far as I know, it has not been done by anybody else. Some time ago, in the *Photographic Magazine*, I had a short paper on the subject. So far as I know, I am the first to use it.

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A PLEA FOR A GENERAL USE OF THE VOLTMETER WHEN TREATING PATIENTS BY THE GALVANIC CURRENT.

By Walter H. White, M.D., Boston, Mass.

"For whose benefit do you write?" is the concise and pertinent question put to its readers by the *Journal of the American Medical Association.*

The *Journal of Cutaneous and Genito-Urinary Diseases* speaks of the "varying resistances encountered in electrolytic work and the necessity for the use of the milliampèremeter, and that text-books give very little advice on measurement of current, leaving it for the operator to find out for himself."

I fancy that there is hardly any member who has not been asked many times: "What kind of a galvanic battery do you use?" "How many cells, strength of current," etc.? So it is for those who would like to use the current understandingly that I speak.

Five milliampères used with twenty volts' pressure is overdone by the one who only knows the ampèrage, if he uses forty volts. This lack of specification is too much like saying "we gave the patient some medicine." If we say the Edison current was used, the chances are one would give the full voltage, when possibly only a small portion of it had been made use of.

Dr. Morton, in his presidential address before this association, in speaking of electricity called it "an exact science." Now, as an association composed of specialists who devote all or the most of their time to the use of electricity as a therapeutic agent, we ought to be exact in our reports of cases both in and out of this association, trying to give the fullest details possible, as we expect and demand in other branches of medicine. Text-books and journals on surgery give the fullest details of any new operation. "Materia Medicas" speak of the number of grains or drops used, giving the fullest description both of the poisonous and physiological action of drugs. In the various special branches of our American Association the members are expected to give *all* details of methods so that any other member can get explicit information in the manner of treatment. Why should not the same be done by the members of this association?

Galvanic batteries vary in their construction, size of plates, and strength of battery-solution, each variation meaning a change of volt-

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age; and many make use of the Edison, or continuous, current. This varies in voltage in different cities. In New York it is 120 volts, while in Boston it is 110 to 112 volts, and the rheostats, or lamps, reduce that down to very small figures. I have a cautery which is used with the Edison current; it was brought to a bright-red heat and did good work in New York, but when in Boston the large knife, taking near thirty ampères of current, could not be brought to a red heat, and had to have a special cord made to use it successfully.

Volt-selectors are not to be depended upon, as we find from the report of our committee on controllers, the markings and the actual voltage not being the same.

I have had made and am using a cabinet furnished with the Edison current which is controlled by means of lamps and rheostats by which the voltage can be varied from 8 to 110 volts and the ampèrage from $^1/_2$ milliampère to over a full ampère if necessary. You can see how misleading it is when I say I used 20 milliampères with the Edison current, and undoubtedly nineteen persons out of twenty treating a case from such a report would give their patient the full voltage, or as near as they could get to it.

In the following cases both the milliampèrage and voltage varied greatly. For example: electricity given in a case with a medicated solution in inflammation of the bladder, 15 milliampères with 28 volts' pressure for 15 minutes; labile treatment of an arm and shoulder for rheumatism, 8 milliampères, 52 volts, 15 minutes; external treatment for emissions, 6 milliampères, 108 volts, 10 minutes; case of neuritis, 2 milliampères, 15 volts, 1 to 2 minutes, each branch of the nerve affected; an intra-uterine case, 30 milliampères, 36 volts, 10 minutes, 1.08 watts, 648 joules, 1200 ohms.

In all of these cases I am simply speaking of the amount of electricity used, and any physician knowing that amount can use either cells or the Edison current. As from the reporting of ampères, volts, and time, it is easy to figure watts, joules, and ohms; then with a thorough description of preparation of the patient, electrodes used, where placed or applied, and the after-treatment, any physician knows exactly what has been done. A good detail of electrical work was given by Dr. M. A. Cleaves in our Transactions for 1897.

I have been trying for some years to get an instrument which will control the current, giving such variation of voltage as would treat the greatest variety of cases without too great expenditure of force or generation of too much heat, and felt that the absence of accurate in-

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formation in text-books and medical journals something for which we were justly criticised.

If authors of succeeding text-books and other papers on the use of galvanism in electro-therapeutics will make use of voltage as well as ampèrage, giving more thorough description in the treatment of their cases, this article will not have been written in vain.

DISCUSSION.

DR. MASSEY: I may say that I agree with everything that has been said, and, more particularly, as Dr. White's remarks were perspicacious, concise, and to the point. But we don't want to burden electro-therapeutics with too much detail work. It is a burden now to those who use it slightly to go into complexities of which they hardly know the bearings; and hence the less said about joules, watts, and so forth, the better. It is of extreme importance in the use of the galvanic current, and of practical importance in conveying arguments, that we should follow up the milliampèrage with stating the voltage from which it was derived, and the duration of the operation; the further statement, as he said, of the nature of the electrodes, being also an important matter. But this additional statement of the resistance encountered is unnecessary. As I stated in a little work some years ago, one might as well say that it is necessary to measure the darkness of this room, rather than the light that we have. Measurements of resistance, when we have a variable resistance to get our current through, are all nonsense, and the less said about them the better. We want to control our forces, of course, stating our results, and the experience from which those results come, and the voltage or pressure. The practical point involved is the question as to whether we get more pain from 2 milliampères from 60 volts or 2 milliampères from 20 volts. That is an important question. I have often been disposed to think, as the result of long work, that the results depend upon the range of resistance of the controller I use, and I have often found that to get 2 milliampères from, say, 20 total volts, I can use my old-fashioned controller better, which has a higher range of resistance variation, without producing pain. In getting 25 milliampères from 20 volts, however, I need more modern controllers with a lower range of resistances. Where there is considerable voltage, a slight movement of the spring is less important, less sudden. For instance, as a matter of proportion, if from 20 volts you wish to give 2 milliampères, with least pain, and have a shunt-controller which reduces the voltage, we will say, to 5, then a sweeping movement of the controller handle is going to make a less sudden increase than if it were 20 volts.

All of our controllers are imperfect in the matter of turning on the last bit of current, except, possibly, those made with a shunt. The uncertainty, and possible suddenness of access, of current as the last bit of resistance is eliminated and an all-metal circuit attained make it wise to use more voltage than actually required, keeping the unnecessary ampèrage down by leaving the controller but partially turned on. Hence I do not believe we should reduce our voltage, on account of these mechanical reasons, as much as some people say. We ought always have enough voltage to give a good value to the resistance changes of our controller.

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DR. SCHEPPEGRELL: I am an advocate for exactness in electro-therapeutics, and I have no objection to adding volts, watts, and ohms, etc., to a description of the clinical history, if it adds to the value of the description. But I will admit that I do not see the necessity of adding the ohms. If Dr. White has given, in a special case, ten milliampères, in a fibroid, why, he puts down so many volts, but if he adds all the measurements he will simply complicate the next case. The next fibroid may have a larger resistance, and it may be very difficult, except by a good deal of extra work, to change the resistance in the electrode, so as to decrease the relative resistance in order to get the same results from the same voltage. As I understand, the remedial value in these cases is dependent upon the ampères. If you pass through the fibroids 15 milliampères, what difference does it make whether you have the 110 original current, if you reduce it with the proper resistance? I have, for instance, a lamp-resistance, by which I adjust the initial incandescent current at 15, 30, or 45, and up to 110 volts; from that I reduce it by the controller of my friend, Dr. Massey, which I find most convenient. If I want a very light current, I use a light voltage of 5 or 10. But that has nothing to do with it. I could get it from the heavier. But as far as the result is concerned, I want a certain number of milliampères for a particular effect, and I think, by adding the voltage, in that case you simply increase the difficulty of understanding the case and its application.

DR. WHITE (closing the discussion): What I wished to bring out was simply volts and ampères. I don't care so much for the joules and the ohms of resistance; these, of course, vary. You may squeeze the sponge a little tighter one time than another, and yet you may have 500 ohms' resistance. It is for the benefit of those people, as I said in the article, who didn't know and want to know. I spoke, in the paper, of using the 20 milliampères, and the chances are that somebody who has just bought an Edison applying apparatus puts on the current at 110 volts, wishing to get 20 milliampères. He has got 20,000 as a total. We can use the current and state the voltage as, say, 50. That is 100 as a total. That is what I mean. The joules and ohms are simply something that any physician can keep for himself, but doesn't tell in public. I think, as has been said, it confuses a new beginner, or anyone who wants to know, with exhaustive details. But I think that the stating of voltage is quite as important as stating milliampères. I think I have answered Dr. Massey.

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ELECTRICITY IN RESPIRATORY AND CARDIAC FAILURE, WITH A CASE OF PARALYSIS OF THE DIAPHRAGM.

By A. D. Rockwell, M.D., New York City.

Duchenne was, I believe, the first to demonstrate that the diaphragm, notwithstanding its supreme importance in the act of respiration, might be completely paralyzed with no fatal results, if uncomplicated with any serious pulmonary attack.

Sudden death may, indeed, follow paralysis of the diaphragm, but in such a case there must be also coincident paralysis of the intercostal and other auxiliary muscles of respiration. As Luschka has shown, the diaphragm possesses a double innervation: (1) a principal and fundamental innervation furnished by the phrenic nerve; (2) an accessory innervation, the source of which is in the last intercostal nerves.

It is only through disease or injury of the spinal cord above the origin of the third and fourth cervical nerves that all the muscles concerned in respiration are paralyzed. Disease of the phrenic nerve below its junction with the cervical nerves permits respiration without seeming effort—notwithstanding the paralyzed diaphragm—so long as the patient remains quiescent.

It is only when muscular effort is attempted that the breathing becomes greatly embarrassed. The following case not only illustrates these statements, and the value of electrical excitation of the phrenic nerve, but is a fitting preliminary to a discussion of its relation to respiratory and cardiac failure.

John B., a musician, aged 38, consulted me on January 9, 1899, for a generally-depressed vitality and especially for an inability to breathe properly. Some three months before he had an attack of grip, but so mild in character as not to prevent his playing each night in the orchestra, of which he was a part. His cold, as he termed it, persisted for several weeks, resulting in increasing respiratory oppression, until finally he was compelled to abandon altogether the wind-instrument which he played. He grew gradually worse, and when I saw him the effort of walking tasked his respiration greatly, while to ascend the stairs was almost an impossibility without two or three halts on the way. He suffered from transient aphonia: *i.e.*, after exertion he could, with difficulty, articulate, and his utterance would be in a whisper.

As the dyspnœa subsided the voice grew stronger and became

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natural. His pulse was 68, and when in repose—sitting or reclining—his respiration seemed not hurried or unnatural, but its unusual frequency, 28 per minute, was readily detected by placing the hands on either side over the ribs, when the quick costal breathing was very apparent. An inspection of the bare chest and trunk revealed very distinctly the essential characteristics of paralysis of the diaphragm. When the patient was directed to attempt a deep inspiration and to breath rapidly, the epigastrium, instead of becoming more prominent, was depressed, with a distinct line of demarkation between the chest and abdominal cavity. During expiration, however, the epigastrium became full instead of sinking—as is always the case in normal respiration. An application of the faradic current to the phrenic nerve, one pole (the positive) being placed at the outer border of the sterno-cleido just above the clavicle, resulted in a deeper inspiration, and a very slight—though appreciable—bulging of the epigastrium. This treatment was repeated every day for one week, and after every *séance* the patient expressed himself as having experienced a certain sense of well-being: greater freedom in breathing and a capacity for increased physical exertion. At the seventh visit I substituted for the faradic current the combined currents—or galvano-faradization. If in your own person you will make a comparative trial of either the faradic or galvanic currents alone, and then the two currents in combination, you will, if your experience is the same as mine, be not at all surprised at the following statement as regards the effect of the latter method upon my patient:—

Whereas by the use of either of the two currents alone there resulted only a comparatively slight bulging of the epigastrium, the currents in combination caused a greatly increased prominence, both of epigastrium and the hypochondria. It was very evident that this combination of mechanical and chemical effects stimulated the phrenic nerve much more powerfully than either current alone. Not only were the objective symptoms thus accentuated, but the subjective symptom of well-being, and an improved condition generally, were most pronounced. Even after the first application of the combined currents there was an ease of respiration that he had not before experienced, and that did not altogether subside in the twenty-four hours elapsing before the second application. From this time the patient improved gradually, but surely, and in a month regarded himself as again quite well.

The action of electricity on the pneumogastric and phrenic nerves

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is one of very considerable importance, and one, too, about which there has been more or less misapprehension. It is a very easy matter to demonstrate in the living man the power of electricity to influence the respiration through the phrenic nerve, but more difficult to illustrate its control over the action of the heart through the pneumogastric. Experiments on animals have, however, demonstrated this power very beautifully, and I have, in man, witnessed several striking illustrations of its action, notably in a case where electrolysis was being experimentally used in a case of cancer of the breast. The tumor had been removed by the knife and the exposed tissue was subjected to the electrolytic action of a powerful current, resulting in an immediate and profound effect on the heart's action. Its beat became for the moment not perceptibly weaker, but alarmingly slow. On discontinuing the current the pulsation immediately became normal, only to slow up again on reapplying it. Thus we see that stimulation of the pneumogastric, either in physiological experiment or in the course of a surgical procedure, calls into increased activity the inhibitory function of this nerve—slows the action of the heart, and, carried beyond a certain point, may arrest its action altogether. Stimulation of the phrenic nerve, on the contrary, is followed by quite different effects on the great muscle which it supplies.

A successful electrization of the phrenic nerve results in a marked increase in the activity of the diaphragm. The inspirations become deeper and stronger, the epigastrium bulges, and the contractions of the diaphragm can even be felt, by pressing the hands firmly over the sides. Basing opinion solely on the results of physiological experiment and observation in surgical cases, the conclusion is not unnatural that, while in respiratory failure electrization is of value, in cardiac failure this method is not only inefficacious, but may even endanger life. It is unnecessary, then, to dwell further on the benefit to be derived from electricity in respiratory failure.

Whether it be threatening death from opium, aconite, or drowning, experience abundantly attests its value, and no one disputes it. A question here presents itself as to the relative merits of artificial respiration and electrization.

It has been claimed that artificial respiration answers all the purposes of electrization in cases of opium poisoning, for example, besides being always and instantly available.

Unfortunately, this simple and most valuable procedure would certainly fail in cases where the other succeeds.

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I can recall two cases of opium poisoning, out of a number treated, where life was saved by keeping up the respiration for many hours, until the effects of the poison wore away and the phrenic nerve began again to resume its function.

It is exceedingly doubtful whether artificial respiration could succeed in such cases. In one case of this kind, where I continued the application for eight hours, its remarkable effects were strikingly manifested. When found the patient was so profoundly narcotized that the respiration had sunk to five a minute. Stimulation of the phrenic nerve, raised it to ten. After two hours of uninterrupted treatment, it had sunk to eight, and if the application was suspended for a moment it fell to about three, showing that the full narcotic effect had not been reached at the beginning of the treatment.

Immediately on resuming the current, the respiration would get up again to eight, and, as the effects of the opium gradually wore away, the frequency of the respiratory act increased, until it reached its normal and the patient was saved.

Now, is it true that electrization, while of value in respiratory failure, is useless or even harmful in cardiac failure, more particularly when due to chloroform-narcosis? To this question my own experimental observations as to the effects of electricity when applied percutaneously to the living man and an experience in two cases of profound chloroform-narcosis lead me to answer quite confidently in the negative.

The vagus is the chief afferent nerve for the respiratory centre, as well as the inhibitory nerve of the heart, and, while it contains both accelerating and inhibitory fibres for this centre, the former largely predominate. Division of the nerve in an animal decreases the frequency of the respiration, but at the same time deepens it, while stimulation of the central end quickens it; and, even were it possible to influence the pneumogastric in any marked degree by percutaneous applications, the effect on the respiratory function, at least, would necessarily be stimulating rather than depressing.

It must be remembered that therapeutic applications of electricity through the skin, by any allowable strength of current, have but little appreciable effect on the function of the pneumogastric. In the case mentioned, where such a profound influence was exerted over cardiac action, the application was made directly to the muscular tissue through needles, the patient anæsthetized, and with an enormous current-strength.

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Percutaneously, it is possible to use only a small fraction of such a current-strength—altogether too slight to appreciably effect the pneumogastric, but quite enough to vigorously excite the functional activity of the phrenic. The benefit that often comes from the use of electricity in exophthalmic goitre has been adduced as evidence that therapeutic applications do appreciably influence the inhibitory action of the pneumogastric. According to my own experience, it is the galvanic, rather than the faradic, current that gives the best results in this disease, while in cardiac and respiratory failure it is the latter that is both most effective and safest. But whichever current is used, in the light of more recent data relating to the function of the thyroid, it is doubtful whether the good effect of electricity in Basedow's disease depends so much on any direct action on the pneumogastric as on the thyroid body itself. Its stimulation acts as an antidote to the hyperthyroidation which is believed to be the toxic cause of the symptom-complex of this disease.

In its report on cardiac failure in chloroform poisoning the Hyderabad Commission said that it was of "primary importance to keep track of the respiration in administering chloroform; if this is kept up the heart will give no trouble."

Apropos of this statement a very interesting and instructive case is related by Dr. D. H. Galloway, of Chicago.[1] He described it as a case of "respiratory paralysis." Under the influence of chloroform the face of his patient became cyanotic, respiration entirely ceased, "but the pulse was fairly good and about 140." Under artificial respiration the cyanosis disappeared in a few minutes, and the pulse became stronger, but, on stopping the forced respiration, all the former symptoms again returned. It was immediately resumed, continued for some thirty minutes, with an occasional momentary cessation, but always with the same result of respiratory and heart- failure. Finally, however, the respiration became permanently stronger, and the patient recovered. "In every case of this kind that has come under my observation," says the author, "the chloroform has paralyzed the respiration, and not the heart." Carefully-conducted experiments by means of cardiographic tracings have shown that induced currents have absolutely no influence on the frequency or force of the cardiac contractions. This would seem to be a sufficient demonstration that no possible harm can come from its use in heart-failure, but it does not dem-

[1] *Journal of the American Medical Association*, February 4, 1899.

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onstrate that the current is valueless in threatening death from this cause, as has been claimed. The promptness and ease with which the induced current, by simple percutaneous applications to the phrenic nerve, quickens and strengthens respiration, while no appreciable influence is exerted over the function of the pneumogastric, renders it a most valuable agent in chloroform-narcosis, as well as from opium, aconite, and other causes supposed more directly to affect the respiration.

SUMMARY.—1. Direct electrization of the pneumogastric and phrenic nerves calls into activity the physiological function of these nerves. In the case of the former the action of the heart is depressed; in the case of the latter respiration is accelerated and strengthened.

2. Percutaneous applications in therapeutic doses, especially with the faradic current, altogether fail to appreciably affect the pneumogastric, while the same method readily affects the respiration through the phrenic nerve.

3. In respiratory failure, therefore,—whether due to the poison of opium, aconite, or apparent death from drowning,—electrization is a powerful antidote.

4. In heart-failure from chloroform-narcosis, also, the faradic current is a legitimate method of resuscitation, by keeping up the respiration, without depressing the heart.

25 East Forty-fourth Street.

DISCUSSION.

THE CHAIRMAN: The paper of Dr. Rockwell is a very practical one, and ought to be discussed well. I hope Dr. Rockwell, in closing the discussion, will give more explanations and definite rules of application.

DR. NEWMAN: There have been several papers written, saying that electricity will paralyze the cardiac nerves. I do not think it does. If it would, then we would have a cessation of the heart's action, and of the respiration, and in Dr. Rockwell's paper I do not see that he mentions this. It is particularly for that purpose that I rise to ask Dr. Rockwell to give his experience as to whether electricity can paralyze the cardiac nerves. I also wish to ask Dr. Rockwell if he can give his electrodes such form and shape that he can say positively or not which will stimulate or paralyze each of the important nerves involved in this region. Everything that Dr. Rockwell says as to the application of electricity to these two nerves has a very practical bearing, and, the more exact and definite he makes the directions to the general practitioner, the more lives will be saved. His mention of opium poisoning is exactly similar to what I have experienced, too, and in entirely hopeless cases. In one case of laudanum poisoning in the wife of a physician the patient's husband applied the current for thirteen hours before consciousness was regained. In another

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case, artificial respiration failing to help, I had to improvise an electrical apparatus, with the assistance of an electrical engineer. The patient was failing, notwithstanding all other means. A faradic current was applied, and she came immediately to. The paper has so much really practical bearing that the more definitely he states what ought to be done in such cases, the better it will be for the general practitioner, who is generally called upon in these emergencies.

DR. MASSEY: I agree with Dr. Newman that this is an extremely good paper, and that it has been very ably treated. I have had an experience that I think will help to elucidate the problems that are presented, incidental to my use of extremely heavy currents in cancer of the head and neck. Before alluding to that, however, I would say that a feature in the paper is extremely important: that we can avoid all danger of interfering with the heart by the use of a faradic current on the phrenic nerve. I think that is probably the most important feature of the paper: a teaching that crystallizes very important knowledge that we have had on this subject before. I am not aware that sufficient attention has been paid to it,—that the question has been at all considered in the last ten or fifteen years. As to the effect of the galvanic current, or direct current, on the pneumogastric, on the heart, or on the circulatory function, this work of mine has been extremely interesting. I have, on a number of occasions, used 500 and 600 milliampères by the monopolar method about the head; that is, the positive pole being somewhere about the head or neck, and the patient lying on a large pad constituting the negative pole. Such a disposition of the electrodes presents the greatest interference with the respiratory and cardiac functions, and I have had one death on the table as the result, from about 500 milliampères being applied to a cancer of the tonsil. That is, I suppose it was an electrical death, though it may have been possibly an ether death, the patient being very fat and with a shallow respiration. But aside from the doubtfulness of the nature of a death under those circumstances, the other cases, where the heavy currents have been successfully used without interference with the vital spark, have been far more important in the teaching result. For instance, in applying the same method to a case of carcinoma on a spot just anterior to the tonsil on the right side, in a gentleman, under ether—almost as bad a case as the one that I alluded to a moment ago, where death ensued on the table, excepting that we had here an extremely strong man—we had the greatest difficulty in attaining a current of 100 milliampères without too much interference with the heart. You can tell in an instant what impression you have made on the heart-action by feeling the pulse quicken and lose force. On turning the current off both circulation and respiration are immediately restored to normal. Both circulation and respiration are weakened by the current, particularly at the beginning of the application. At the expiration of half an hour, and by a fuller use of ether, in this case we were enabled to turn the current on to about 360 milliampères, in that spot, which was maintained for an hour, without the patient's welfare being at any time risked. What does that teach? It teaches that our difficulty in this instance was not due to the immediate action of the current upon the nerves, but it was due to the reflexes not having been paralyzed by the ether. In other words, the excitation of the pneumogastric may be of reflex nature, as we well know the excitation of taste and sight and hearing are. Some years ago that

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was thoroughly demonstrated by a case in my own office. Taste excitation, by weak currents, was abolished, in an anæsthetic area right close to the mouth; and it has been shown in other cases that the special galvanic excitation of taste, and the other special senses, is performed by reflex action, and not by direct penetration. So in the class of cases under consideration. Abolish those reflexes, which doubtless arise in sensory nerves, and then, without being on the danger-line, from the anæsthetic point of view, we can use a far more powerful current close to these nerves, without risk. I wish to ask the doctor how many milliampères were used in the cancer-case about the breast.

DR. ROCKWELL: The case to which I referred was treated long before we had the milliampèremeter, but I can tell you about how much it was, I think. It was probably over 100, and perhaps 200.

DR. MASSEY: In a recent case of cancer in the left breast, immediately over the heart, treated successfully, so far as the local disease was concerned, but in which the patient has since, I understand, died from metastasis, I was able to determine the exact resistance of the patient to the depressive action, under the disease which she had. In other words, I determined that under a local circuit, with one electrode, the positive, right over the heart, and the other distributed about two inches away, 800 milliampères were safely reached after the current was turned down several times. But above that amount would cause the pulse to weaken—so much so as to compel us to turn the current off entirely for a time. In every instance the slightest turn off of the current would cause, in all of these cases excepting the one I spoke of as dying, a resuscitative effect. Now 800, on a local circuit, is quite different from the same amount from a single pole in this region, with the patient lying on a large electrode—in other words, having the heart lying between the two electrodes, one being three-fourths of an inch from the heart itself. I found that four and five hundred was as much as one could use in this latter position with the left breast, though that may be maintained a long while—an hour to an hour and a half, to thoroughly disintegrate the growth by electrolytic and cataphoric action.

Another branch of this very important work I wish to allude to, without taking up too much time. That is, what can be done by electricity for persons suffering from weak heart. Usually it is assumed that nothing can be done; —that we are dealing with a dangerous agent, in the use of electricity; and intelligent doctors commonly instruct their patients with weak heart-action that it would not be safe to go to electro-therapeutists. The unskilled electro-therapeutist may, of course, use the current in such a way as to affect the pneumogastric nerve unfavorably. But in one instance I have had a singularly beneficent result from the use of electricity in such a case, suffering from fatty degeneration of the heart, in which there was arhythmia, and the method employed was merely labile dorso-abdominal galvano-faradic currents, the faradic current being highly contractile. The result was due to stimulating the other side of the nervous structure of the heart, the sympathetic ganglia, which are in close connection with the general abdominal sympathetic system. The patient lay on a large pad, and a pad the size of the spread hand, well moistened and soaped, was moved over the very flaccid and relaxed abdomen. We used currents of about 50 to 100 milliampères. Every time that that patient was sub-

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jected to this treatment and the heart-action noted before and afterward, it was demonstrated that arhythmia would temporarily disappear after the treatment, and the patient would be better for a time in many respects. As a result of continuous treatment the patient was very much improved.

DR. SNOW: Mr. President, perhaps it would be well to allude to another current. I wish to allude to an electrostatic current. It has been in use a little more than a year. It was published in the French journal in March, and in the *Electrical Engineer* subsequently by Professor Morton. It is known as the Morton wave-current. In this current the matter of ampèrage, as we know, plays no part, but voltage is all-important, because voltage is what we are using in producing and obtaining the result. Dr. Rockwell, in his paper, alluding to goitre, referred to the stimulation of the heart by the galvanic current. I wish to state here that the effects of the electrostatic wave-current upon a case of goitre which I have been treating have been most satisfactory, not only from its effect upon the heart, but upon the goitre. The case came under my observation in June. It was a pronounced case of Basedow's disease. The pulse at the first sitting was 160, and the patient complained much; it seemed that in walking one block she felt that she must sit down several times. The dyspnœa was very pronounced, which I attributed, and do still, to the affection of the heart more than to the respiratory function. But I wish to state this: that that patient, having a little electrode applied over the larynx or over the goitre, followed by a spinal electrode, one inch in width and about eighteen inches in length, over the spinal column, for twenty minutes, employing the one over the goitre for ten minutes—after two weeks her pulse was uniform—below ninety—and the patient had no dyspnœa whatever, and has not had up to this time; but the goitre has rapidly disappeared under the treatment. Combining, as I have, by electrodes, the spinal and the local methods, I am not able to judge which has produced a greater effect, nor whether the results are to be attributed to the constitutional effect of the current or to the local effect. But I do say this: that the patient to-day is in as good a condition of health as ever in her life; that she has received no medicine whatever; that she has received no drugs during the whole course of the treatment; that her treatment has been daily for the first month, and it has remained so, with Sundays excepted, and with an occasional miss; that at the present time I am continuing the application principally of the electrodes to the eyes, placing the metal plate over the eyeball. Perhaps that seems the most irrational of all the procedures; but I will state that the eyes are going back to their normal position. I expect that at no distant day I will publish the case, and I say now, it seems to me that to another current as well as the galvanic current may be attributed the controlling influence or the stimulating effect on the heart-muscle, because, after the first treatment, the patient's pulse, which was 160, fell to 90, and after two weeks' treatment it remained uniformly at 90. I simply make this statement with the idea that it may lead to other investigations; and perhaps Dr. Rockwell could explain the reason for this effect upon the dyspnœa.

DR. WAITE: I would like to ask you a question similar to that asked by Dr. Newman, as to the kind of electrode used in treating the sympathetic nerves. Some years ago I had special electrodes made for that purpose.

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DR. SCHEPPEGRELL: So far, Mr. Chairman, we have only discussed two methods of applying the current to the phrenic and pneumogastric—one, by the tissues of the skin, and the other by means of needles. Now, there is one other method of application by which we get results sometimes, when they are least expected. I refer to the use of galvanism in electrolysis, in the treatment of structure of the œsophagus. There we have a surface which offers, compared to the skin, very little resistance to the action of the electricity. It is not a case of having, as has been mentioned here, an ampèrage of 200 or 300 or 500 milliampères, but the action takes place when you apply 2 or 3 or 5 milliampères. I have seen a case where at 6 milliampères I have had to cease the application. And I would also suggest that that avenue might possibly be a means of applying it in the case suggested by Dr. Rockwell.

DR. ROCKWELL: In regard to Dr. Newman's question, I think, if you will do me the honor to read the paper again as published, you will see that those questions are answered. I hold in the paper that it is impossible for any external application, with any current, to affect the pneumogastric nerve to an extent sufficient to serve as a means of arousing respiration. Neither can we do it by the faradic current; but the phrenic nerve can be effectively reached by any current, and therefore we need not fear the action of either current on the heart, when there is no danger of heart-failure.

In regard to Dr. Snow's suggestion about the electrostatic current, it may be said that it is a peculiar current, and it is a current of value. But static apparatus is so cumbersome that you cannot take it with you when suddenly called to a patient suffering from respiratory failure. Now, so far as the use of that current is concerned in the case of goitre, I prefer the galvanic current, and yet I think it was a Frenchman who claims to have cured a number of cases by the static current. I always doubted that until the new theory was brought forward in regard to its causation by autointoxication. In that case we can understand how the current would affect the vitality. But I don't think that a single case of exophthalmic goitre teaches anything. Exophthalmic goitre is an affection that demands care and caution in reporting results. I did not venture to describe any until I had forty-five cases, and at the present time I have nearer seventy-five cases of exophthalmic goitre. I believe only a proportion can be cured. Eight or ten cases is all that I have seen cured, of seventy-five. These are conditions so severe that we can only come to conclusions by developing a large number of cases, and not depending upon two or three or a single case.

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MODIFICATIONS OF BOTTINI'S GALVANOCAUTERY OPERATION FOR HYPERTROPHY OF THE PROSTATE.

By Robert Newman, M.D., New York.

Hypertrophy of the prostate differs from prostatitis in that it is a disease appearing in advanced age, generally not painful, scarcely sensitive to the touch or to instruments. The cause of it is not an inflammation, and some authors describe it as an atrophy of the normal tissue, with an increase of a neoplasm of fibrous and glandular tissue. The enlargement acts as a mechanical obstruction to the bladder, which prevents a free flow of urine. Thereby the bladder is constantly affected, gradually causing cystitis, residual urine, dilatation of the muscular wall of the bladder, frequent micturition, and often retention. Other sequels of the obstruction to the passage of urine are ureteritis with dilatation of the ureters, pyelitis, and pyelonephritis.

Symptoms as described, the age of the patient, the irritable bladder, the frequent desire to micturate, the mechanical obstruction, the gradual increase of the trouble, make a differential diagnosis more certain by an examination, both by sound and a digital exploration per rectum. Some patients may have an hypertrophied gland which is drawn upward into the bladder and which does not obstruct the passage of the urine. Such a state is an exception to the general rule, but the digital exploration will make the diagnosis.

Treatment of prostatic hypertrophy has changed from one extreme to another. In former years the patient was condemned to use the catheter for a life-time, which was a very indefinite period, and generally increased the troubles of the bladder. Nowadays, surgical operations are made *per urethram*, perineum, rectum, or by the suprapubic route, and prostatotomy or prostatectomy in different forms are practiced. Electricity has been used in different ways, as galvanism, electrolysis, thermo-electricity, galvanocautery, and galvanopuncture, the last being performed either through the urethra, rectum, or as operations: suprapubic, perineal, etc.

Bottini's Operation.

It is more than twenty years since Bottini devised and practiced his own operation with the galvanocautery.

How wonderfully medical circles have changed their opinion about this operation! For years it was not noticed. Later some authorities

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reported adversely about it, as they did about any electro-therapeutic measure. At the present day a great change has taken place and an avalanche of literature has appeared, reporting cases and favoring the operation; to some, reference has been made in the annexed bibliography of this paper.

Bottini's operation consists in burning a passage through the enlarged gland by galvanocautery, thereby enlarging the passage and removing the obstruction. The burner is made of heavy platinum incased in an instrument resembling a lithotrite. The burner is heated red or even hotter by a storage-battery, and by a screw slowly advanced through the obstruction. Antiseptic precautions are advisable, particularly in regard to the bladder. It is still a mooted question whether the bladder should be filled with air or water. A local anæsthetic to the prostatic portion is absolutely necessary; cocaine is preferred. Some patients may choose ether-narcosis. Several incisions forward and backward may be made, if the operator finds such a procedure necessary. During the passage of the burner the operator may guide by placing one finger in the rectum. The whole operation may be completed in a few minutes.

Attracted by the first reports of this operation, the writer used it several times. The late Dr. Guleke, of New York, had imported an original Bottini instrument with which he and the writer operated several times. These operations were made in the years 1882 and 1883, and, as they were not satisfactory to us, their details were not particularly reported, but my own objections were treated of in other papers.

This fact explains the incorrect statement of recent reports in 1897 and 1898 that "the Bottini operation has never been performed in this country."

Not having had the expected result from my experience with the Bottini instrument, I constructed my own galvanocautery-sound for the treatment of hypertrophied prostate, which was demonstrated in a paper read in the Surgical Section at the thirty-seventh annual meeting of the American Medical Association at St. Louis. The paper was published in the *Journal of the American Medical Association,* August 28, 1886. This instrument, in a new garb and improved, was exhibited in a paper read at the International Medical Congress, September 8, 1887, in Washington, entitled "Galvanocautery-sound and its Application, Especially in Hypertrophied Prostate." It was published in the "Transactions of the International Medical Congress" as well as in the *New England Medical Monthly,* December, 1887.

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In these papers I have described the Bottini method, given my full appreciation, and also stated the objections. If I had not performed Bottini's operation I would not have been able to criticise it, nor would I have devised my galvanocautery-sound, which has worked very satisfactorily. While the writer admires the genius of Bottini, he objects to the following points from his personal experience in 1882:—

OBJECTIONS TO BOTTINI'S OPERATION.

1. The instrument was clumsy, unhandy, and heavy.

2. The platinum burner was so thick that it got hot too slowly and too gradually, and when hot lost its shape by bending, so that sometimes it would not move back into its beak.

3. The very large storage battery was too heavy for transportation, and a smaller instrument did not generate enough heat.

4. The instrument was shaped like Heurteloup's lithotrite, the end having only a short condee. Such an instrument is exceedingly difficult to introduce, and in many cases of hypertrophy unintroducible, the mechanical obstruction leaving no space for its passage.

The intention is to push the instrument into the bladder over and beyond the enlargement of the prostate, then to reverse it inside, so that the beak is turned downward. The galvanocautery-knife is *à la caché*,—inside the beak,—and moves outward by turning a dial on the handle, while the battery heats it, thereby making a central cut and division in the obstructing prostate.

5. The result of this operation was very uncertain, sometimes causing shock, pain, inflammation, and irritated the bladder, and the exfoliation of the scabs caused by the cautery gave occasion to more complications. It may be stated here again that the effect of galvanocauterization is really a burning process through the tissues, entirely different from electrolysis, which is a chemical absorption caused by a current of 5 milliampères in treating strictures of the urethra, while the galvanocautery needs 12 ampères, at least, and even more if the platinum knife is thick.

6. The patient has to remain in bed for weeks, and from some reports of Bottini himself it shows that voluntary micturition occurred only after twenty-four days.

7. The operation was not free from different dangers and accidents.

Among others, Professor Rydygier made other objections to

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Bottini's operation in the *Wiener klinische Wochenschrift* of January 5, 1899.

For the above reasons I constructed my

GALVANOCAUTERY SOUND.

The instrument is catheter-shaped, of smooth, polished metal, with a short curve at one end; at this end is a fenestrum, in which is placed the platinum wire, the burner to be heated. A serpentine form is best for this wire; each end is firmly attached to one of the two copper rods inside the tube, and represent, respectively, the positive and negative poles. The other end of the instrument is straight and forms the handle, in which commence the copper rods, each of which is fastened to one of the pins, or heat-conductors. These two pins are connected with two electric cords by binding-screws. The other ends of the two electric cords are fastened, respectively, to the positive and negative poles of the battery. The current-breaker is movable, and, when set straight and pressed firmly down on the screw, electricity is evolved and the burner instantaneously heated.

The improvements consist in:—

1. Having the handle in one light, convenient piece.

2. Having the current-breaker under the immediate control of the index finger.

3. Having the fenestrum filled up, whereby the instrument is more thoroughly insulated and less liable to become heated.

4. Having the tube filled up, thus preventing it from getting wet or blocked with *débris* inside.

A storage battery is used to heat the wire; the potential must be regulated by a rheostat.

Modus Operandi for Hypertrophy of the Prostate with Newman's Galvanocautery Sound.—The galvanocautery sound is connected with two electrode-cords, and attached by the other ends to the respective poles of the storage battery, the potential tried and regulated with the rheostat. The prostatic portion, to which the cautery is to be applied, must have been ascertained, and the distance from the meatus measured. The instrument is then introduced so that the fenestrum, with its platinum wire, is in contact with the part to be cauterized. The operator will know by touch when the instrument is in the right place, and the measure will corroborate the correctness of the situation. One hand holds the instrument in this place firmly, while the other hand

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sets the battery in motion, and then the current-breaker is placed in a straight line and pressed firmly upon the screw; a flash follows, and the raising of the finger from the current-breaker disconnects the current. In one moment the operation is finished and the instrument withdrawn. It causes no pain, and in some instances the patient scarcely believes that anything has been done. He is able to walk about and is not detained from his business. In cases of very sensitive patients, I have used cocaine injections, but it was scarcely necessary. The *séance* should be repeated in about three days, or even two. The instrument must be kept scrupulously clean, as the cautery will fail if there is dirt between the connections.

The question now arises: how does this method bring about a cure? The end sought is, first, to remove the obstruction, so that the bladder can discharge all the urine, and at regular intervals, and then to reduce the prostate to its normal size. The theory is that the cautery first acts as a tonic and next as an astringent; the mucous lining shrivels up, and the glandular tissue contracts, and by shrinkage the size is diminished. The stimulation gives new life and healthy action. Each repetition of the operation acts similarly, and perhaps on another part of the hypertrophy. The operation must be continued until the cure is effected. Care must be taken not to overstimulate, and cause prostatorrhœa, prostatitis, etc., thereby creating or aggravating the very ailment we seek to cure. The cautery must be given just severely enough to accomplish the object and no more. If the cauterization is too prolonged and too deep, the glandular action is overtaxed and weakened, and will be followed by a terrible prostatorrhœa, which takes a long time to cure. At the same time an inflammation is created, which causes pain and swelling, and, at last, the too greatly cauterized tissue will slough away and may cause septicæmia.

For these reasons I prefer the slow method described, and am opposed to rapid methods or too deep cauterizations.

In treatment of the enlarged prostate by galvanocautery it is absolutely necessary to pay attention to other symptoms and troubles of the patient, according to established principles. Pain must, at all hazards, be allayed. While the galvanocautery is used it is of the greatest importance to attend to the state of the bladder, by drawing off the urine and irrigating it.

This treatment is indicated in all cases of enlarged prostate, where urgent necessity for immediate relief does not exist, and particularly in such cases where the patient is ambulant. It is useless if the patient

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is in the last stages of albuminuria, where uræmic poisoning may carry him off at any moment. The earlier the treatment is instituted, the better the results that may be expected.

Detailed reports of cases and cures have been related in the paper read at the International Medical Congress in September, 1887, and that method has been continued with perfect satisfaction to the present time.

A modification of Bottini's apparatus was made about two years ago by Freudenberg, in Berlin. This device is a great improvement, and rectifies some of the objections experienced in former times. Freudenberg describes his alterations as follows:—

The modifications in point are relative to shape, handiness, and electrotechnical construction, affording, at the same time, the possibility of sterilization.

The modified instrument is provided with a stout, cylindrical, grooved handle, strong and steady in the hand, quite resembling the well-known handle of a lithotrite.

The cooling apparatus is inserted on this side of the handle, instead of at its farther extremity, thereby obviating incandescence of the handle, and securing the rubber hose of the cooling apparatus from being compressed by the ulnar aspect of the hand.

In lieu of the platinum blade platino-iridium is used, this alloy being harder, and so less apt to bend, and by reason of its electrical resistance permitting of the employment of a weaker current for rendering the blade incandescent.

Another addition consists in the conduction of the current ascending to the knife within the guide through a single wire only, equaling in volume the two wires used in the original instrument; the descending current passing through the hull proper, and, by reason of its close contact with the cannula, through the entire length of the external instrument. Moreover, greater steadiness of the blade, riveted as it is to the inflexible hull, has been insured. The connection of the instrument with the conducting-wires has been achieved by a process corresponding with the axis of the instrument and leaving both poles in a concentric arrangement. A slight jerk will move up the corresponding cable-attachment to which the cables are fastened; these are united to one conducting-wire, and, owing to the improvements of electrical construction, are much thinner than formerly.

Interpolation and interruption of the current are effected by a minute screw, superseding the special interrupter of the original appa-

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ratus. The last alteration is the employment of a water-proof and heat-proof putty, which, by tightening and isolating the apparatus, allows of its being treated *in toto* like any other surgical instrument, not only as to antiseptic solutions, but as to sterilization in boiling water: a process which could not formerly have been applied without seriously damaging the instrument.

The operation as modified by Freudenberg has lately become a favorite one with the profession, and within the last few months many reports have appeared, some of which are mentioned in the annexed bibliography.

While Freudenberg's improvements are very good and rectify some of the objections mentioned, the writer suggests hereby more modification before this association as follows:—

1. Omitting the water-cooler, in order to make the mechanism of the instrument simpler. The water-cooler is an impediment, takes up space, and needs for its proper management a special assistant. If the burner is smaller, it does not need so much heat, which can be controlled more easily. It has been questioned whether it is better to dilate the bladder with water or air. Either has advantages and objections. It is preferable to prevent the heat from injuring the bladder, which may be accomplished by

2. Separately insulating the two conducting-rods, which convey the heat from the battery to the platino-iridium burner. Each of these conductors is attached to either end of the burner, and each separately is insulated in its own case. Such an arrangement would heat the burner immediately and prevent the heating of other parts of the instrument.

3. The end of the instrument is conical and of a smaller size, in order to pass the obstruction and enter the bladder more easily. Thereby the operation can be performed in those cases in which the larger-sized instrument could not be introduced.

4. A tunnel at the conical end for a filiform guide, over which the instrument runs. This facilitates the introduction of the instrument, and makes it more certain that false passages are impossible. The filiform guide may be omitted if the operator wishes.

5. The burner of platino-iridium is smaller and stationary and thereby cannot get out of shape and place; besides the greater heat is avoided.

6. Protector of burner, which if moved acts at the same time as a

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meter, the operator thereby knowing the exact place in which it would be desirable to have the burner.

7. An endoscope illuminating the parts, so that the operator can observe the result and progress of the operation. This would be desirable, but not exactly necessary, and is difficult to execute, as the place for such an attachment would make the instrument too large. A hint is here given only that an inventor may show his genius for improvement.

The new instrument with the modifications enumerated, except the endoscope, has been made by George Tiemann & Co., of New York, and is put before the association for criticism in the discussion.

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DISCUSSION.

DR. SCHEPPEGRELL: I waited for some of these gentlemen to open the discussion in a branch to which I have not given much attention. However, from a medical stand-point, I can make a suggestion with some experience. I have found that the adding of the contact-point to the instrument is not only detrimental to the operation, but is an inconvenience. That, of course, applies more particularly to cauteries that are used in internal canals or cavities, where the cautery-point is sometimes in a very dangerous region and has to be controlled. I find, for instance, in a cautery that you are applying to the larynx, that just the pressure of the finger to make a contact is sufficient to displace it and make it touch a place which you do not desire. Instead of it, you may have a foot-switch. I have a foot-switch which I can attach at any point I like, which is moved on a broad surface, which does not easily oxidize, as it does in the handle. It is more convenient, and gives you a delicacy of touch which is better than you can possibly get in an instrument which has the contact in the handle.

DR. WHITE: I know that in our city the foot-switch is largely used. Dr. Newman may have special reasons why the contact should be used in the handle, rather than with the foot-switch.

DR. SNOW: It would probably make less difference with this kind of work than it would with throat work.

DR. NEWMAN: The suggestion of Dr. Scheppegrell applies more forcibly to work within the throat than the urethra, as it is often necessary to repeat the short, blast-like burns a number of times, allowing the burner to cool meantime. This method of burning is not painful. My instrument is not exactly perfection, but I should like to hear it criticized, and suggestions made for its improvement. This one has been made only for this occasion for me, and I was anxious to present it here.

DR. OSMAN: I would like to ask the doctor if he is obliged to use a sound afterward to keep up the dilatation.

DR. NEWMAN: The report is that a catheter has to be introduced after the operation, but not to keep up the dilatation. The Bottini operation is a galvanocauterization which destroys the tissues and removes the obstacles to micturition at once. The catheter is to be used only to remove *débris*, and not exactly to develop dilatation. It is about the same operation as cutting with the knife. The question is whether the knife or the thermocautery is to be used to do the cutting. When I got up this instrument I called upon several

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operators who have operated successfully, and each operator had a different idea. In a case where the patient has not so large an hypertrophy the operation might not only do harm, but be followed by a fatal result. These operations have to be done with a great deal of discrimination and caution.

DR. OSMAN: This is a knife, the same as a cutting knife. Don't you get cicatricial tissue, and is not there a danger of making it worse with this knife than if you had let it alone, unless you put in a dilator?

DR. NEWMAN: I can only answer that Bottini has done the operation several hundred times, and has had success. Theoretically, I would join entirely with you, but practically it must be admitted that patients have been cured, some operators having patients recover the third and fourth day.

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GALVANIC EFFECT PRODUCED BY HIGH POTENTIAL PRIMARY CURRENT.

By Dr. R. J. Nunn, Savannah, Ga.

At the outset of this paper it is necessary to define what is meant by a "High Potential Primary Current," and to make this perfectly clear it is well to describe at least so much of the apparatus used as will make it plain even without the use of many technicalities.

The battery employed consists of ten cells of the chloride accumulator, giving a little over 2 volts each, coupled in series, and giving therefore 22 volts at the terminals. The description of the elements is as follows. "Type D. Size of plates, 6 inches by 6 inches. Number of plates in each cell, 9. Discharge in ampères for 8 hours, 10; for 5 hours, 16; for 3 hours, 20."

The current from this battery is passed through the coarse primary coil (No. 16 wire, B. & S. guage) of a faradic machine and gives a voltage of 21 at the patient's terminals; the apparatus is completed by the use of a Carpenter rheostat to control the battery-current, a Bailey controller as a variable resistance in the vibrator-shunt, a condenser of 4800 square inches of surface to moderate sparking, a McIntosh rheostat (and in another apparatus a Bailey controller in shunt is used) in the patient's circuit and electrodes such as are used in applying the continuous current.

This apparatus gives a unidirectional interrupted current having about 30,000 interruptions a minute, the velocity being so great that a Weston voltmeter at the terminal of the patient's current remained steady at 21 volts, and the milliammeter showed between 400 and 500 milliampères.

The ample quantity in reserve in the chloride accumulator shows that, if greater ampèrage is required at the patient's terminal, greater voltage will be needed to carry it through.

This voltage is as much as the majority of patients can bear through a 6-by-8 electrode for a sitting of the usual duration,—say, twenty minutes.

In applying this current the same precaution as to contact must be taken as in the case of the continuous current; but it is well to bear in mind that the current will be diminished proportionately to the resistance of the electrodes.

The ability to bear current varies greatly in different patients;

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some easily bear all the current flowing through the apparatus, while others could take but a small portion of it; and again the resistance of some patients varies immensely from day to day.

When a current of this character has been applied with the positive on the sacrum and the negative on the abdomen and the full quantity has been administered, it has been observed that the surface of the mucous membrane of the vagina is anæsthetized, but the effect is only superficial, not extending to any depth. It is still a debatable question whether or not this fact should be considered as demonstrating interpolar action.

The advantage which this form of apparatus gives is that by its means the much-sought-for combined effect of the galvanic and faradic current can be had, and therefore the therapeutic possibilities of this current are very great; but it is by no means suggested as intended to supplant other forms of electrical application, but only as furnishing an additional weapon to the armamentarium of the medical electrician.

One of the immediate general physiological results manifested in some patients is thirst. This would seem to indicate considerable chemical action. After a time stimulation is shown by flushing of the face, and at this stage it is well to terminate the applications or it will be succeeded by a condition of fatigue and consequent depression which it were best to avoid.

This form of current has been applied successfully in cases requiring catalytic action, as in tumors and kakoplastic deposits or growths; in one case a small tumor in the skin came by chance within the sphere of action of the negative electrode which had been placed on the abdomen. This tumor disappeared in a few days, and it was exceedingly interesting to see it gradually diminish in size from day to day.

One of the most interesting cases was that of a nulliparous married woman who had suffered an attack of appendicitis with an extensive formation of pus in the abdominal cavity, for which she had undergone an operation. The immediate result of the inflammatory process was extensive adhesion of the contents of the abdominal cavity until the capacity of the vagina was only about 10 cubic centimetres. Under the use of the current the adhesions were absorbed, until at the time of discharge of the patient the cubic capacity of the vagina was about 100 cubic centimetres. The actual time of treatment was about twelve months, involving between three and four hundred applications of the current, although, owing to various interruptions in the course of treatment, it really extended over a period of about two years.

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This case is remarkable, as well for its favorable result as for the admirable faith and confidence displayed, and the unusual perseverance and steadfastness of purpose exhibited by the patient.

That the result was a complete cure was evinced by the occurrence of pregnancy within a short time after the discharge of the patient.

In neuralgic pains it has proved useful, notably in a case of sciatica of central traumatic origin. Atonic dyspepsias have also been markedly benefited.

A case of reflex asthma which had resisted every other known treatment has been much relieved, with a fair prospect of ultimate cure, and so on through a long list of applications.

Altogether it is hoped that this form of current will be worthy of acceptance by the members of the American Electro-Therapeutic Association.

DISCUSSION.

DR. WAITE: I would like to ask Dr. Nunn what his connection was. Was that a primary coil only?

DR. NUNN: It was a primary coil only.

DR. WAITE: Connected up in the usual way?

DR. NUNN: Yes, connected up in the usual way. That is to say, I use any coil, but I connected with a primary coil.

DR. WAITE: Then you do get an interrupted current, in one way,—practically a galvanic-tension primary current?

DR. NUNN: Yes.

DR. WAITE: In the primary coil of a faradic current when the circuit is closed you have no current to the patient, because it passes around the coil, the resistance being very little, and when the cell-current is broken the current of self-induction has but one way to travel, and that is through the patient. You have therefore a unidirectional faradic current.

DR. MASSEY: This is a current of the kind that the voltmeter would not measure at all. It would measure the initial cell-current, but it would not measure those quick rises of potential, of infinitesimal duration, for which a special sort of apparatus is required. In other words, the doctor had a current of higher potential than he thought he had. The Weston voltmeter only measured the continuous voltage of the 10 cells in the circuit. This would give the 21 or 22 volts, which were mentioned by the reader of the paper as having been shown by the voltmeter. At every interruption of the current there was a rise of potential proportionate in height to the number of turns of the primary wire around its coil, and that rise is much more than 22 volts—somewhere in the neighborhood of 100; it depends on the number of turns. It is this higher potential current of infinitesimal duration that is the primary faradic current—a very valuable current if you minimize your resistance. If, on the contrary, the resistance of the patient's circuit is high, any other primary run by 1 little

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dry cell would be as good as the current of Dr. Nunn. But if you have one electrode in the body and another large moist electrode on the surface, bringing down the resistance to 100 or even 200 ohms, then you have from this powerful cell-battery a current somewhat different from any that we have ever had before. It has its value, as I said; but, to determine how much, you want an entirely different form of voltmeter from one that only represents a steady voltage.

DR. WAITE: The fact that Dr. Nunn has brought this out and experimented on it shows that he has got a good current. Now, to reproduce that you want the same kind of wire, the same kind of coil, and the same number of winds that he had in this case, and then you will get the same voltage. When the circuit is closed, you have in the terminals the same number of volts that you have in your cell, because the resistance of the coil is very low and probably would not show but a fraction of an ohm. But when the cell-circuit is broken you have practically a high-tension galvanic current. You have a current which has not been used until you brought it up. To derive the benefit of it, you should give the exact details of your coil and of your cells. Then we will know exactly what to do to reproduce it.

DR. MASSEY: I would like to add to what I have said that I have modified my opinion that all faradic currents were of equal value. During the last three or four years I have laid stress on the importance of the primary faradic current, where the total resistance of the patient's circuit was small. But you do not get a contractile current from every apparatus, because the primary is often very poor.

DR. NUNN: In concluding the discussion, I am very much obliged to the gentlemen for the remarks they have made, and I will change and modify the paper so as to include the items of information that Dr. Waite has kindly mentioned were necessary in order to complete the experiments.

I didn't take that view of it before, because I thought those details unimportant. It was a very short coil, a simple kind of wire, and altogether I thought there wasn't very much in the current. Now, as to the effect which Dr. Massey has mentioned, the effect of this current is altogether different, and partakes largely of the effect of the galvanic current, producing eschars and burns, and all the other phenomena that you would find in the galvanic current if it is used incautiously. Of course, if the electrodes are properly placed and carefully used, you will have none such, and it seems to me that in that way you can employ a galvanic current for a long time, and perhaps with deeper effects than with the ordinary current.

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THE THERAPEUTIC ACTION OF CURRENTS OF HIGH FREQUENCY IN ARTHRITISM.

By Dr. Georges Apostoli, Paris.[1]

[Note of the translator: There is no technical term which exactly translates the word *arthritisme*; the nearest term probably is "uric-acid diathesis," or diminished excretion of waste-products of the human organism.]

On two different occasions, in 1895 and 1897, I published notes on the therapeutic action of these currents, confirming clinically the physiological discoveries of Professor d'Arsonval. At present, in collaboration with my assistant, Albert la Guerrière, I wish to report a *résumé* of my work from January, 1894, to June 1, 1899, and wish to submit the general conclusions that I think we may derive from this treatment of arthritism.

I had arranged my first papers on two parallel proofs that mutually corroborated one another. First, clinical proof on the examination of the patient; second, chemical proof by examination of urine made by Dr. Berlioz. I can to-day, thanks to the obliging collaboration of my friend Dr. Tripet, add, to the former provings, that of spectroscopy of the blood, after the method of Henoch, and I here give the general conclusions drawn from my investigations:—

(*A*) Clinical proofs, began in January, 1894, in my clinic as well as my office. Nine hundred and thirteen patients were submitted to 24,371 applications, local or general.

The total of my clinical proofs seems to me amply sufficient to uphold my first conclusions of 1895, and which were strengthened again by my paper of 1897; they demonstrate, in an incontrovertible way, the powerful general action of the current of high frequency on nutrition, which is stimulated and regulated. This fact shows itself constantly by the progressive restoration of the general condition, the improvement of strength and energy, the return of appetite, better sleep, better digestion, reappearance of cheerfulness, resistance to fatigue, and ability to walk.

(*B*) Chemical proofs: This has been investigated 1038 times in 469 cases by Dr. Berlioz. We have in this way confirmed, in a parallel, yet independent, way, the clinical proofs given above: Improvement of general diuresis, more complete elimination of excretions, super-

[1] Translated by Frederick Schavoir, M.D., Stamford, Conn.

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activity of combustion and organic exchanges, and a tendency toward the normal proportions of uric acid and urea (1:40).

(*C*) Hæmatospectroscopic proof: This proof has been practiced by Dr. Tripet on 112 cases in the last year, and a total of 200 examinations have been made before, during, and after the treatment. These facts will be shortly published, but let it suffice to-day to point out two principal points. Dr. Tripet has measured at the same time centesimal proportions of oxyhæmoglobin and also the power of reduction, which indicates the activity of nutrition. He has found parallel modifications, which prove the undeniable influence of those currents on nutrition; therefore, under their influence, the reduction of oxyhæmoglobin is brought back to a normal standard by the diminution of its activity which has been previously exaggerated, as, for example, in diabetics; or by its increase if it had been reduced, as in arthritics. If we now group together these proofs we must forcibly conclude that the action of these currents is powerful and undeniable on the general nutrition, and in this we find conclusive confirmations of the physiological researches by Professor d'Arsonval, who really was the first to suggest their therapeutic applications. Let us consider for a moment how these currents act in diseases to which they are applied. The subject is too vast to be discussed in one paper, and to-day I am going to limit myself to arthritism.

We will successively pass in review, basing ourselves only on results and on facts that have been well observed, each principal manifestation, as follows:—

1. Rheumatism.
2. Gout.
3. Migraine.
4. Neuralgias.
5. Lithiasis.
6. Varicosities.
7. Hæmorrhoids.
8. Constipation and digestive disturbances.
9. Eczema.
10. Asthma.
11. Vascular disturbances.
12. Neurasthenia.
13. Arteriosclerosis.
14. Obesity.

RHEUMATISM.—It is here that the triumph of these currents is

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most manifest, although they are not a panacea nor applicable to all cases. We will study the three periods of rheumatism which are clinically observed: the acute, subacute, and chronic, for each period responds differently to the treatment.

(*A*) In the acute form contra-indication is manifest, as it had been already so determined by electro-therapeutists for other forms of electrical application, galvanic and faradic, and we do not believe that the application of currents of high frequency is justifiable in an acute rheumatism, being liable to aggravate the disease, as has been proved clinically a number of times. This does not surprise us if we consider the physiological action of these currents.

(*B*) In the subacute forms there may be partial contra-indication to the use of these currents. This is, however, a question of tact; we can try these applications in a moderate degree and short sittings, taking into consideration any intolerance manifested which should be the criterion whether to continue or discontinue the electrical applications.

If there is tolerance and even a slight amelioration at the beginning, a continuation of the treatment is strongly indicated. But we must not forget to maintain a positive reserve in these subacute cases, as they may at any time take on an acute form, which may be caused by too-active treatment.

(*C*) In the chronic forms of rheumatism the currents of high frequency have a most remarkable efficacy; whether we have to deal with a primitive attack, or consecutive sequences to an acute attack, our experience of five years permits us to formulate the best prognosis with this treatment. It is in these cases really that our efforts have been almost invariably crowned with success, and again in these cases we should neither despair of success too soon nor expect too much in too short a time. If in a given case a slight amelioration is even very long in showing itself, we must guard ourselves against discouragement, but persist; if in another case, on the contrary, a decided improvement takes place in the first few sittings we must not get overconfident, but always guard against relapses. Let us not forget that to a chronic disease we must oppose a medication of long duration. It is impossible to formulate fixed rules for this treatment. We will simply give the results of our experience: Continue the application for as long a time as the lesions are variable in their gravity and in the length of existence. Never stop on account of slight amelioration, but persist until a positive result is obtained. If several months seem to us necessary

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with quotidian applications, we must not hesitate to tell our patients so. And it must always be told them that this medication is rarely successful unless faithfully persevered in.

From 25 to 30 consecutive sittings are generally the minimum required, and sometimes it will be necessary that after a few days of rest a second, or even a third, series of treatments may be necessary. In some patients we had to go to 250 to 300 sittings, and this tenacity has most always been crowned by success. It is sometimes useful to combine general applications with local ones on the most painful spots, and we can affirm that in our hands in all cases persistently treated marked ameliorations have been the rule, most generally equivalent to a true cure.

GOUT.—It is impossible for me to form at present definite conclusions on this subject, as my experience with these cases has not been extensive enough. All I feel authorized to state is: "That the application of these currents is of great benefit in gouty manifestations, without being in any way a specific."

I have seen in three cases in the beginning of the general treatment an attack of gout break out which could not have been foreseen; whether this was a simple coincident, or a relation of cause and effect is impossible for me to say, and these facts have induced me to make some reservations which I will here formulate: First, not to interfere in the acute stage. Second, apply in cases of gout a mild treatment in the beginning, which may be progressively increased in duration and strength. Third, suspend at once all applications on the appearance of any exacerbation, and wait until the acute attack has passed. Fourth, do not hesitate to prolong the treatment for several months, as that is generally necessary. Never promise a patient the disappearance of the enlargements of the joints, as they may persist after the disappearance of all symptoms. Fifth, assure the patient of a symptomatic recovery, and the constant return of strength with complete health if the treatment is sufficiently persisted in, even if the gouty symptoms do not yield at once. Sixth, we are justified in believing that a lengthy treatment will prolong the interval between gouty attacks, and will prevent almost completely their return.

MIGRAINE is such a complex affection, and which, even without general arthritism, may be induced by a number of different conditions, that we cannot formulate any uniform rule for its treatment. All we can say is: "That if an attack of migraine resist our electrical applications, we may at least prevent their return, our treatment act-

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ing as a prophylactic." We have had cases where we were able to relieve our patients during acute attacks, and also diminish their frequency, intensity, and duration. In some cases the treatment was not persevered in, but we have no doubt that the treatment is always beneficial in interrupting the periodical recurrence of the attack.

NEURALGIAS.—What we have said of migraine can also be applied to neuralgias. If due to arthritism only, these electrical treatments generally prevent the periodical attacks. We had, for example, several cases of sciatica where the treatment restored a healthy condition and stimulated vitality. Our knowledge concerning neuralgias is still obscure and incomplete, as we do not understand clearly the lines which separate neuritis from neuralgia, and therapeutic applications would not be as successful in the one as they might be in the other.

In arthritic neuralgias we have used singly or jointly general and local applications. Under the single influence of general applications we have seen more or less rapid results, such as the disappearance of pain and the progressive re-establishment of functional power in the neuralgias of the extremities. Of the local applications the results have been more variable. At times we obtained a durable sedation; at other times we procured a considerable analgesia of short duration; and sometimes we did not obtain any appreciable result. In a few cases the results were unfavorable, producing congestion, with an increase of pain and a feeling of fatigue. If these failures were due to the medication proper or to the operative technique we are not prepared to state. This is a subject which will stand investigation, and probably result in fixing the question of dosage and duration, as well as indications for local or general applications. That which we can say positively at present is that we have in this treatment a powerful weapon against arthritic neuralgias, such as sciatica, in preventing the return and curing the disease.

LITHIASIS.—In the different lithiases,—hepatic, nephritic, and cystic,—which so frequently accompany general arthritism, the currents of high frequency are destined, as Mr. Moutier has pointed out, to occupy an important position for the prevention of these accidents. And we have been able, under their application, to notice amelioration, consisting in lengthening the interval, attenuating the intensity, and even ultimate disappearance of the attacks.

It is by modifying nutrition and metabolism that we can interpret the therapeutic process of this treatment, and we must guard against expectations of an immediate curative result. It is only after a lengthy

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use of several months that we may expect any results. In this our treatment resembles the cure of Vichy, where patients have to return sometimes for several seasons before obtaining the desired result.

I have never observed the expulsion of a calculus under this treatment, and I doubt whether the facts which were published by others on the subject were not simply coincidences. That which seems to me, however, well established, is the preventive action of the electrical treatment in lithiasis, as it arrests, or at least retards, their evolution.

VARICOSITIES.—In some cases which we observed a diminution of the varicosities ensued, and the troubles occasioned by them were relieved under the double influence of local and general applications. The *modus operandi* of the currents is hard to explain entirely; the results are probably due to the analgesic action and the relief of congestions by local application, and the influence on nutrition of the general applications, which stimulate peripheral circulation and functions.

HÆMORRHOIDS.—We may apply the same theoretical consideration to hæmorrhoids as given above; it was inaugurated by Professor Doumer, of Lille, and we have been in a position to confirm several times the improvements in these rebellious manifestations of arthitism. Here the local application with a rectal electrode is necessary; to this is due the majority of successes published. We must not lose sight of the fact that general treatment might be also beneficial without local applications, but would be infinitely more prolonged. The action of the local treatment can be easily interpreted if we consider that in this disease consecutive pains—spasmodic contraction—are associated with inflammatory phenomena, local irritation, pruritus, erythema and eczema, constipation, and digestive disturbances.

In questioning our patients who had been treated by currents of high frequency, we often ascertained the disappearance of an habitual constipation and progressive improvement of other digestive troubles without the use of any other additional medication. We need not be surprised at this, as we can easily explain these beneficial effects; sometimes local applications to the abdomen have conquered rebellious constipation, sometimes we added to this general treatment by electricity.

In this direction further investigation is indispensable, as constipation is due to so many causes,—either nervous, local, or arthritic, —which may at times escape the action of uniform therapeusis. We have often noticed disappearance of digestive troubles due to or associated with arthritism, such as dilatation of stomach or intestine or

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renal ptosis. Constipation and dyspepsia related with gastric and intestinal atonicity are generally benefited by this treatment.

Eczema.—Currents of high frequency are very efficacious in eczema, and generally in the different cutaneous lesions associated with arthritism, modifying these either by reflex action on the diathesis of the subject, or acting directly on the affected points by local application. High-frequency local applications seem to give analogous results to those of static applications described by my friend Professor Doumer. It was Dr. Oudin who first inaugurated these local applications of high-frequency currents with the aid of his "resonator," and he showed us that with this application alone, even after the first sitting, a diminution of the pruritus was marked; furthermore, the eczema attenuates progressively, the redness and congestion disappear, and every symptom is eliminated if the treatment is sufficiently prolonged.

Asthma.—I have only had a few cases of arthritic asthma to treat, not numerous enough to have built upon them any permanent conclusion, but I feel authorized to believe that in these currents we have a precious resource to modify the ground on which are prepared the evolution of respiratory troubles in a great number of arthritic patients. We have been able to note under their influence rapid amelioration with marked diminution of dyspnœa, easier locomotion, and freer respiration, and we hope to have further cases to confirm our previous observations.

General Vascular Disturbances.—In our experience and therapeutic proving of high-frequency currents we have incidentally observed a marked action in certain vascular disturbances which accompany arthritism, such as hot flashes, facial congestions, and cold extremities. Our patients spontaneously call attention to marked improvements in that direction, and we are justified in crediting this to the treatment.

Neurasthenia.—In several former papers I have specially devoted myself to the treatment of this malady, and I have submitted, with the assistance of Dr. Planet, very conclusive observations that permit me to divide neurasthenics into two principal groups: First, hysterical neurasthenics. Second, arthritic neurasthenics.

The different symptomatology of these groups seems to justify a therapeusis which would indicate, for the hysterical group, static electricity, while the high-frequency currents are indicated in the arthritic group. As our experience becomes larger, numerous facts arise to corroborate our first conclusions, and, although admitting that there

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are mixed forms of the disease that might be benefited by simultaneous application of the two currents, we are more and more convinced that our classification is justified. It was to general applications that we resorted in arthritic neurasthenia. We reserve for our next paper the privilege of returning to this subject and to complete it by studying the value of local isolated applications on the vertebral column, which have been suggested by Dr. Moutier.

ARTERIOSCLEROSIS.—We cannot yet group a sufficient number of these cases treated to permit us to formulate positive therapeutic conclusions. It is only incidentally that we observed notable ameliorations, which encourage us to continue on those lines. We do not believe that the vascular lesions are directly influenced, but it is probable that, in modifying the general nutrition, there may be a resolution of these lesions of sclerosis—that they may gradually disappear.

OBESITY.—It is especially in arthritic obese patients that one could hope to exercise any influence on this condition, and they are the ones who will derive the most benefit from a treatment which increases the liberty of motion, makes walking easier, and favors the excretion of urinary waste; our clinical experiences have confirmed our theoretical surmises, and demonstrated that prolonged treatment with high-frequency currents has, in many instances, diminished obesity, not in a direct way, but by a secondary action regulating nutrition.

Arrived at the end of this paper, the length of which I hope you will excuse, I wish to state that, without considering high-frequency currents a panacea which will cause to disappear all manifestation of arthritism, I yet think that the *modus* of this therapeutic application is destined to be one of the most powerful weapons when well handled, and will give the best results in the treatment of this diathesis.

These are my conclusions:—

If the static current remains the agent "*par excellence*" against hysterical conditions, the high-frequency current is the most efficacious against all pathological manifestations of arthritism.

It is, above all, an agent acting on the cell, and a powerful modifier of nutrition generally, which it can increase and regulate at the same time.

DISCUSSION.

DR. WAITE: If Dr. Apostoli had given a definite statement of his apparatus, his electrodes, and the method, we would have been in a better position to understand his paper. He has not given these details, so that we do not know anything about the number of winds or coils, or anything. I simply mention

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this to show the importance of giving a detailed statement in a discussion of the apparatus, if one is going to transmit knowledge of these matters. These coils, I believe, are going to be made, and take quite an active part in electrotherapeutics. I am making one, and at another meeting I will be happy, not only to show the apparatus, but to show its construction.

DR. MASSEY: I think the lack of explanation is because this question is in a more advanced state in France than it is here; and the kind of instrument is not described, I presume, because I understand that it has been described on previous occasions several times. In this connection I wish to allude to some experience that has been had in Philadelphia recently with an apparatus of this sort. Such was the force of the testimony to the value of currents produced by this apparatus, which I conceive to be a Tesla apparatus, very similar to what was shown to us at Lynn, Massachusetts, on one of our previous meetings—such was the strength of the testimony as to this high-frequency current, in driving ozone, as it was claimed, into tubercular cavities within the lung, that it took the attention of a physical scientist in Philadelphia, whose wife was suffering from consumption. She went to New York and came back very greatly benefited. That was about a year ago in June, and finally in the fall of the year she was so much interested as to induce her husband, who was a physician by education, but a chemist by occupation, to bring the attention of the Franklin Institute to it as a claim for a new method for the cure of consumption—as a method by which the passage of a current from a single pole of this high-frequency apparatus through the lungs would change the oxygen of that portion of the body into ozone, in such quantities as to kill the organized bacillus of consumption, without even breaking the skin. The Franklin Institute took it up, and I am now one of a subcommittee of its Committee of Science and Art to investigate the claims of the method. In the meantime, before I was a member of this subcommittee, the committee induced the German Hospital to make a place for this apparatus, and it was brought over there and tried on a number of cases. It was brought over in February last, and a number of cases were put under it. As a result of the work at the German Hospital, under some harsh criticism and in a hostile environment, the admission was made by the physicians that, either as a result of this application to the chest or of the baths of ozone and light, in the cases subjected to it the blood showed a decided increase of leucocytes. Some cases lost weight rapidly, but there was also a claim on the part of the promoters of the affair that there was an increase of weight in some cases. Unfortunately, however, the matter was brought to a close by the claim on the part of the hospital doctors that the operator had been detected in giving medicine to a patient under the method. He then withdrew it, and removed it to another portion of Philadelphia, and we expected to look into it this fall. In the meantime the doctor's wife died of consumption. She was temporarily improved, but it did not last. There have been no further facts developed in the case as yet, but I can see that this machine must have a very extreme value in cases of arthritism, as mentioned, and that it forms the best way of changing the oxygen of the air into ozone for breathing purposes; but as to the claim of ozone production from the oxygen of the tissues in amount sufficient to act as a microbicide without breaking the skin or causing any other apparent change of the body-surface, I do not believe there is anything whatever to demonstrate

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the truth of it. I think, however, that this paper is a very definite contribution, and the immense power displayed by the apparatus I have referred to, so far as the senses can measure it, indicates that all of us who are able to do so should take this up and procure machines.

DR. SNOW: Mr. President, I would like to insert a few words here on that very line. I have been closely associated with Professor Morton during the last two years, in this very subject of high-frequency currents. Our work has been devoted to high-potential static currents, and I believe that Dr. Morton to-day obtains better results with the high-potential, high-frequency current than the records of Apostoli testify as to the use of the high-frequency current. It is in the high-potential current, with low angles,—it is in that sort of current which we produce to-day with the static machine,—that we are to see, I am confident, the greatest results that have been obtained in electro-therapeutics. The electrical results to which Apostoli alludes in his strong lines are most pronounced in the current obtained from the static machine.

Now let me briefly describe the current to which I allude, which is the kind to which I referred this morning. It consists, in the first place, in placing the patient upon the insulated platform,—the negative or positive, be that as it may. We do not believe that polarity has anything to do with the results of the current. The patient is connected with the positive, the negative is grounded, the poles are nearly closed, and the machine is started. The electrode that has been applied, if you please, before starting the machine, consists of a metal plate, always placed next the skin, never over any intervening surface, for obvious reasons. The machine is started, and the gap is gradually widened to conform to the idiosyncrasies of the patient. For the constitutional treatment we use the long, spinal electrode, about an inch in width and eighteen or twenty inches long, which is passed along the spinal column, underneath the clothing, a pillow placed at the back, and the patient pressing close against the pillow, which has the electrode close to the skin over the spinal column. Now, the patient will endure a voltage of from 500 to 600 volts, as estimated, with a spark-gap of 5 or 6 inches, receiving the same shunt of the current as is jumping across the spark-gap to the opposite pole. Directly under the plate a vibratory action is created, which is felt by the patient, not only locally, but seeming to tingle through the nerves of the body to the different extremities. The general idea that static electricity is on the surface must be eliminated from the results in the use of these currents. As the skin becomes moist, the current passes readily through the tissues. After the first five minutes the place to which the electrode is applied becomes wet, and as we remove the electrode after the treatment it will be covered with drops of water, and the patient after the first five minutes breaks out into a gentle perspiration. There is nothing in the effect that is unpleasant, there is nothing that is in any way disagreeable to the patient, but the real tonic effect of that treatment is wonderful. I have seen cases of neurasthenia, which have had no relief for years, relieved after a few months' treatment, completely, without any medicinal treatment. I have myself relieved an acute neuralgia, sciatica, a tic douloureux, in fifteen minutes' treatment, for twenty-four hours, by one application of that current to the painful spot. So that I say that the remarks of Apostoli in his paper can be emphasized in every particular, even to the treatment of rheumatism, and affirmed by actual tests.

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RHEUMATISM.

By Charles O. Files, M.D., Portland, Maine.

In the February issue of *Sajous's Monthly Cyclopædia of Practical Medicine* a leading article on rheumatism gives what is supposed to be a synopsis of our present knowledge and of the most reasonable prevailing theories of this disease. For instance, Reinhard declares it to be an infectious disease, the infectious agent entering the system through abraded mucous membranes, usually of the pharynx. He claims that the proper and efficient prophylaxis consists in the frequent use of some antiseptic mouth-wash. Strümpell defines acute articular rheumatism as an infectious disease. He affirms that "this view of the disease, which was first brought forward by Hüter, is the only one which enables us properly to understand the symptoms and course." Among American writers the causation of the disease is generally referred entirely to the imperfect elimination of urates, or, in other words, to the uric-acid diathesis. It is possible that rheumatism may be proved to be of infectious origin. It is certain that in rheumatism there is faulty elimination of urates. Some of the explanations offered for the symptoms of this disease are fantastic and unreasonable. Most physicians would hesitate to offer a mouth-wash as a reliable prophylactic agent to ward off rheumatism in case of a person about to be exposed to a severe cold by keeping on wet garments while the temperature is down to zero.

The conclusions arrived at by Mordhörst, as the result of chemical experiments made by him, in relation to the cause of the symptoms of rheumatism, are the most reasonable that have yet been offered. The following statements made by him are of special importance: "The phenomena of rheumatism rest upon the accumulation of urate spherules in the connective tissue and cartilage. Acids favor in the extreme their precipitation. Urate spherules are naturally subject to oxidation; urate needles are not." When the urates are in the form of spherules they cannot readily pass through the capillaries. When they are in the form of needles there is little or no difficulty in their progress. The salicylates "favor the transformation of urate spherules into urate needles. This explains why these salts cut short the inflammatory process, but predispose to relapse, which is due to the needles persistence in the tissues." These conclusions, the result of positive

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chemical experiments, lead us inevitably to imperfect circulation as the concomitant of imperfect elimination of the urates for an explanation of the symptoms of rheumatism.

Prof. Max Verwörn has demonstrated that "respiration and the circulation of the blood are not elementary phenomena, but are the consequence of the contraction of the respiratory muscles or of the heart-muscles. In these muscles the activity is due to the power which the muscle-cells possess of changing their form, of becoming shorter and thicker. This power is not derived from nothing, but from energy developed through chemical changes within the cells in strict accordance with the universal law of the conservation of energy."

This energy may also be developed by the use of external stimulants, such as heat, massage, stimulating lotions, and electricity. Uric acid and the urates are excreted by the kidneys, lungs, skin, and bowels. If these organs are properly fulfilling their functions, there will be no excess of urates left in the blood and tissues, unless there is a constant renewal of the agents, in the form of food or drink, favoring the formation and precipitation of these urates. We usually find in rheumatic subjects a sluggish liver, inactive kidneys, slow respiration, and constipated bowels. Perspiration is generally free, showing that Nature is trying to force out through the skin the *débris* which should have been removed by the other excretory organs. One of the most successful patent nostrums used in rheumatism acts very powerfully, and probably solely, on the bowels. The blood acts as a stimulant to all the organs and to all vital tissues. In passing through the kidneys, for example, with the normal force or impetus, and at the normal speed, the blood gives up some of the urea, urates, and other excrementitious matter contained in it. If the rate or force of the circulation is diminished, the excretion goes on at a slower pace, and some of the effete material is retained in the system. If the respiration is slow, the respired air is less in quantity, and the amount of excretion from this source is lessened, and some waste and injurious material remain in the blood. The blood, like electricity, goes most freely where there is least resistance. If the hands or feet, for example, are exposed to external cold, the capillaries contract and offer resistance to the passage of blood, and consequently a less quantity is allowed to enter them. The decrease in the quantity of blood—which is the source of heat—in turn subtracts from the normal amount of heat in the parts, and causes a still further loss of heat if the same degree of cold is maintained. If now the urate spherules are unable, from the narrowing of

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the calibre of the capillaries, to pass through them, there will be swelling, pain,—in one word, inflammation.

If this is the correct theory of the swelling and pain of articular rheumatism, and, in cases of lesser obstruction, of subacute and muscular rheumatism, then the following is a logical plan of treatment:—

Give alkaline mineral waters; keep the bowels open; eat only those articles of food which will make good blood with as little waste as possible. Use such systemic remedies as will favor the transformation of urate spherules into urate needles. This can be accomplished by the use of some preparation of salicylic acid, preferably the salicylate of ammonol, which, of all the salicylates, is least likely to make disturbance of the digestion.

Of all kinds of external treatment, the best is undoubtedly the use of electricity. While benefit may be derived from the faradic or the galvanic current, the static breeze, spark, or massage is the most convenient and the most efficient; in fact, the majority of cases able to come to the physician's office can be cured by the sole use of static electricity. A statement to that effect made by a physician, who for ten years has treated cases of rheumatism almost every day, ought to have some weight even if no satisfactory explanation of the rationale of the treatment had been made. If the statement is true, there must be an explanation of the fact. It is no true explanation to offer a glittering generalization like the following, which appeared in a recent medical journal: "Static electricity tends to restore the equilibrium of the system."

Professor Verwörn has given the key to the mystery. The electric current furnishes the energy which causes the muscle-cells to change their form, becoming shorter and thicker, thus becoming the *vis a tergo* which causes increased rapidity of the circulation and deeper and more rapid respiratory movements. The increase in the supply of oxygen thus furnished stimulates the activity of the glands and of the organs of excretion, and uric acid and urates are removed in the regular physiological method. So much has been written about the technique of administering static electricity that little remains to be added. The great objection to using the roller has been that the clothing is often so moist from perspiration, or from external dampness, that the current is not felt. This trouble may be obviated by using a soft, dry, woolen shawl, spreading it in two, four, or eight thicknesses over the part where the massage is to be used. In a great many cases it is better to have the patient stand on the floor rather than on the insulated platform.

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If the patient requires a stronger current than is obtained in this manner, the crown, connected with the opposite pole, may be placed over his head at a suitable height as he stands on the floor; then the roller may be used, or sparks may be drawn in the usual manner.

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THE ELECTRICAL TREATMENT OF SCIATICA.

By Charles R. Dickson, M.D., Toronto, Canada.

It has always appeared to me that one of the best methods of increasing the interest in the study of the application of electricity in medicine and surgery would be to devote a portion of the time of each meeting of the American Electro-Therapeutic Association to the consideration of the treatment of some of the diseases most frequently met with in general practice, which, while proving rebellious to other forms of treatment in vogue, are especially amenable to electrical technique; and with this end in view I have ventured to present a theme for which I make no claim to originality, but yet out of which, perhaps, discussion of great value may be elicited. This is my only excuse for intruding on the valuable time of the association.

Sciatica is a *bête noir* of the general practitioner, and for that reason has been selected as my subject. How often is the physician disappointed in his well-meant, but fruitless, endeavors to combat it with the means usually at his disposal or laid down in his text-books as appropriate. And yet it is one of the many cases where the patient employment of electricity will almost always reward intelligent efforts.

It is not claimed that electricity will be found an infallible cure in every case of sciatica, but it so often cures when all else fails that it at least merits a trial, and no physician can be said to have done his whole duty who, in the treatment of this obstinate condition, has neglected to call to his aid electricity.

No hard and fast rules can be laid down for the treatment of all cases, and very much will depend on the judgment of the physician, and not every one will attain the same results, and, if a physician has not himself a comprehensive grasp of the theory and practice of electrotherapy, he had much better hand over his sciatic patients to a more fortunate *confrêre*.

The diagnosis of the exact condition should be made with great care, and we must be persuaded that the trouble is really sciatica.

When the affection is still in the acute stage, and we have reason to suspect that inflammation is still active, the indication is for the use of the constant current.

A large stabile pad connected with the positive pole of the battery is placed over the epigastric region of the patient next to the bare

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skin, and the negative small labile pad is held for a short time upon each tender spot, being slid from one to another as required.

When the electrodes are in position the current is turned on gradually until the meter registers from 5 to 10 milliampères, rarely the latter; it is wise to begin with a small dosage and to avoid the production of pain; a decided feeling of warmth is all that should be experienced; the labile electrode should be removed to another spot if the feeling of heat becomes unbearable. When all points have been gone over, the negative pole may be connected with a large stabile plate electrode on which the foot of the affected limb is allowed to rest; the small labile pad is then connected with the positive pole and applied over each painful spot as before.

In cases of great severity the applications may be daily, but usually three times a week will be found sufficient, and an opportunity for reaction be thereby afforded. In any event it is not well to prolong an application more than twenty minutes.

The rationale of such a course is to obtain the counter-irritant, analgesic, and absorptive effects of electricity.

When the more acute symptoms have subsided, but the trouble still persists, more energetic measures may be employed in conjunction with the former, and the aid of static electricity be invoked, recourse being had to the long, positive spark, moving rapidly over all points of tenderness, following with a positive spray, thrice a week, static electricity having a very marked effect upon tissue-metabolism.

When the disease has become chronic, and degenerative changes have manifested themselves and the surrounding muscles have become atrophied, the induced current may be employed with advantage, the high-tension current being preferable. The muscles may thus be exercised, while at the same time advantage is taken of the sedation of high tension.

Measures, such as suggested, when carried out with cautious vigor and patience, will very frequently be rewarded with success.

DISCUSSION.

DR. CLEAVES: I feel very much interested in the treatment of all diseases, and perhaps especially sciatica, by electricity, and I have the record of hundreds of cases of sciatica which have been treated solely by electricity without the use of drugs. Almost without exception I have used the franklinic, or static, electricity, and in the more acute cases I have made use of the faradic, either with the positive or the negative insulation.

Still, Dr. Dickson very wisely says that a great deal must be left to the

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physician in charge of the case, to his comprehensive knowledge, not only of electro-therapeutics, but of the condition of the patient under care. Sometimes a case of sciatica will yield to the effects of the galvanic current and another will yield to the static. In more acute cases, where there is very great sensitiveness, I think it is wiser to use the static current, and my treatment is similar to that of Dr. Dickson. I am not in the habit of placing the electrode at a given point, but spreading it over the painful area of the patient; but I believe we get the best results when we make the contact mainly at the central point. In many of the cases that I have had under care, and of which I have a record, I could show the results that have been obtained where the cases have been, of course, of rheumatic origin. Some cases of traumatic sciatica give good results, and have been some of the best that I have treated: one, a year ago, where a man who was playing bowls made a misstep and injured the nerve just at the pelvic emergence, and had had intense pain for many months when he came under care, and he made a perfect recovery. Another case of an ice-man, sitting on the ice, who had a bad sciatica, and was treated for a long time with other methods. He was put at rest in a bed in the hospital, but without any good results, yet has made a perfect recovery under the use of the franklinic current. When you remember that the object of the use of electricity is restoration of the tissues, we understand why we get such good results in sciatica or any form of neuritis. All such cases have yielded either to the galvanic current or the franklinic.

DR. OSMAN: I would ask whether Dr. Cleaves uses any solution—salicylic or the like—by cataphoresis?

DR. CLEAVES: No, I never have, because I have gotten results without it, doctor. I have been in the habit of using, for the past year, the galvanic current, with very good results indeed. I frequently find that an application for twenty minutes gives relief for at least twenty-four hours: that is, in the acute cases which have had a history of a month at least. But in the cases which have become chronic, I do not believe there is anything as good as the franklinic spark, directed immediately on the sensitive part, applied until there is complete sedation at the time of application, so that the patient leaves your clinic or your office completely relieved; and this result will follow where it is properly applied. In all my cases I have never known it to fail. I wish to say that, in some cases that are called sciatica, I find, also, that the nerve is affected, and in those cases, in examining, I particularly diagnosed the seat of neuritis in the lumbar plexus. I had a young man come to my office a few months ago who had not slept at night for six weeks, who applied for electrical treatment, and said that that morning it took him an hour to get out of bed and into an upright position. My first impression was that it was lumbago, and in those cases we generally apply the sparks. I found that the region of affection was in the left side, not in the vertebral column, but over the region of the plexus on the left side. In that case I made the direct application of the static plate, and placed the point electrode at a spot directly opposite, using the gap of about four inches, and localized the high-frequency current by placing the point electrode directly in front, with a good current. I made about six or seven applications to the young man, and it was all the treatment

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he had. Whether the disease advanced until it was finished or whether it was cured by the application I will not judge.

DR. MASSEY: There is a point in my experience I would like to bring out in this discussion, that has convinced me that my method of application to acute sciatica has been radically wrong. The last case that I had of sciatica in bed turned out to be a case where the patient's husband delicately intimated to me that I had better try something else, after a few days' application. I remember to have had a similar experience with several other cases, and, oddly enough, they were all bedridden cases. As some of you know, I have a habit of heroic dosage, and especially with the galvanic current. I have treated all these cases with the galvanic current, having had a successful experience with both the galvanic and static currents in chronic cases at the office. But, of course, these bedridden cases could not have the static treatment, and I had then to use the galvanic alone. But oddly enough, they had a way of becoming dissatisfied after I had been at work several days with 30 or 40 milliampères, with nice large electrodes. It is evident from this experience that I have been using too strong a current in acute neuritis, and that the acuteness of the stage of the disease contra-indicated strong galvanic currents. I have thought, also, that the application of wet electrodes was bad. I did not use necessarily cold water, but the towels would lie in contact with the patient during the half-hour,—and they would get cold even if the application were a quarter of an hour: at any rate, the treatment didn't turn out well. I give this experience for what it is worth. I have had invariably high success in the treatment of more chronic cases in the office, with both currents, both galvanic and static. The conclusion that I came to in this last Waterloo was that the next time I was called to a bedridden case I would use a high-potential faradic current, carry the battery to the bedside, and see if it did good work. I would confine my efforts to the decrease of pain, and, from our gynæcological experience in the use of high-tension currents, it would be distinctly indicated. It is possible, of course, that a weaker galvanic current, of 2 or 3 milliampères, would have done better.

DR. CLEAVES: I confirm what Dr. Massey has said in regard to the inadvisability of treating acute sciatica with the galvanic current. I think, when we remember that we have an excess of fluid attracted to the part by this current, we have something that is going to act as an additional stimulus to the acute inflammatory conditions. In regard to what Dr. Snow said, everything depends upon accuracy of the application to the site of the disease. The application may last five minutes or ten minutes. The cases would be better if they had daily treatment. In those cases that do so well, that are well enough to give up after one or two treatments, it is hard to say whether the cure is due to the treatment or whether it is a case that might have done well anyway. I have experienced that oftentimes, whatever current we use; whether the kind that the doctor has spoken of, with the metallic plate and the current-connection, or by means of the spark. With the use of the plate the application is less painful than with the spark.

DR. NUNN: Mr. President, I desire to call the attention of the speakers to the fact that we are, to a great extent, neglecting the work done by the

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association in the past. If you recall, several years ago, in one of the New York meetings, Dr. Hutchinson brought forward his instrument, the singing rheotome, and drew attention to the fact that instruments, made to vibrate with a high velocity, as in the singing rheotome, with exceedingly-high current-voltage, produce an effect which is of value in these cases. We forget the work that the association has done. It would be very well if those who were not members then would read up some of the Transactions of the association, and they will find many excellent suggestions.

Another question here is that question of polarity. There certainly is a difference in the action of the poles, even in a current of this nature. Perhaps it may be well to mention at this moment some little personal experience. It amounts to very little, but it shows that we talk too much of generalities, and too little of the facts. I had an inflammation of this joint of my little finger some year or two ago, and it is generally said that the static has no chemical effect, that the static is a current of too-slight ampèrage for chemical action. I wound around the finger a wire attached to one pole of the static, and it had the effect of taking away the whole of the inflammation of the joint, together with the arthritic deposit, which was absolutely taken away, showing the chemical effect. I have never seen that done with any other current, and only bring it forward to show that I do not think we fully realize the effect of all the currents that we use.

DR. SNOW: I should explain the doctor's results as due to a metabolic effect rather than a chemical effect.

DR. DICKSON (in conclusion): I have very little to say, Mr. Chairman, except that I am pleased that the paper has elicited the discussion for which it was written; not that it has any value, but the discussion which it has elicited is of great value. In regard to what Dr. Nunn has said of the singing rheotome, I will say that I have not forgotten it. I had heard a great deal of the effects of the singing rheotome, to which our *confrêre*, Dr. Hutchinson, introduced us; but I would remind Dr. Nunn that the singing rheotome did not attract much attention after the paper was read. The singing rheotome was a great disappointment, not only to Dr. Hutchinson, who devoted a great deal of time to it, but to the manufacturers, with whom I have talked several times about it, and they were all very much disappointed with it, and I have yet to find a physician whose word could be relied on who was satisfied. If anyone has produced the effect that he hoped to produce with this singing rheotome, I shall be very glad to hear it, and to amend the statement which I have made. A great many claims have been made, and we ought to blame the French for these claims. The French are a very enthusiastic nation, and what goes in France cannot be expected to go in Canada or in the United States, or in a great many other countries. From the way in which that statement is greeted, I am sure that a great many here agree with me. Fortunately in some cases, unfortunately in others, there are some of us who are very enthusiastic. We should always be enthusiastic, especially in regard to anything relating to electro-therapeutics; but we should not carry our enthusiasm beyond the bounds of the possibilities. We should not ask electricity to do too much. There are certain things that it cannot do. I think we all appreciate

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that electricity can do some things much better than other agencies that can be called in. Therefore I think we should ask electricity to do these things, and as for the things which we would like it to do—we must hope that some day our wishes will be rewarded. At the present time there are many things which were very highly lauded at the time of their introduction, for results which, I regret to say, have never materialized. The singing rheotome is one of the number.

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SOME INTERESTING CASES OF RADIOGRAPHY.

By Dr. Fouveau de Courmelles, Paris.[1]

It is quite difficult at the present time to bring forward anything that is new in radiography, because the field has been so thoroughly explored that there is nothing left but questions of detail. That was the opinion to which I gave expression before my class at the Medical School of Paris in 1897, where, by the way, I gave the first teachings in radiography ever undertaken.

But in the field of medical application of the x-ray matters of detail are important. I will here quote a case in which the question of procedure was very doubtful, but where former experiences induced us to follow an expectant course.

Dr. Bernheim brought a child to me, about 6 $^1/_2$ years of age, of good family history, and who had been in good health up to the time of an accident. It appears that the little girl, on the night of October 15, 1898, fell out of her bed. Dr. Collardot was immediately summoned, and diagnosed a backward dislocation of the elbow, which he tried to reduce at once, but without result. The next day, October 16th, the dislocation was reduced without anæsthetic, and the arm placed in a sling, applying, at the same time, an ice-bag, on account of the enormous swelling. Under the influence of quiet and the cold the elbow gradually became reduced in size, so that after about eight days I was able to make another examination, during which I discovered a fracture of the lower extremity of the humerus. I at once placed the arm in a plaster apparatus and in as good position as I could obtain. However, I had observed an hyperostosis on the anterior surface of the inferior end of the humerus, which I attributed to hyperostosis of the neck. I tried in vain to mobilize the joint, but even the slightest motion was accompanied by very severe pain, and I then decided to take a radiograph in order to get an explanation of the cause of non-success. It was then seen that the patient could not move the joint on account of a separation of the inferior extremity of the epiphysis of the humerus, and also on account of the enormous hyperostosis previously described. The olecranon process had not been injured and was in its place.

What was then to be done? Was surgical intervention indicated?

[1] Translated by F. Schavoir, M.D., Stamford, Conn.

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We thought not, because, in a child of that age, the nature of the epiphysis of the humerus is well understood, and, as to the hyperostosis, the chances for resorption were good. For these reasons we decided not to interfere, but simply placed the elbow in as favorable a condition as possible.

On February 18, 1899, we took another radiograph, and found that the hyperostosis had been almost completely absorbed and the head of the humerus had come back to its normal shape and position. A sort of osseous band seems to unite it to the olecranon. The duration of exposure for the three pictures which I took were 45, 60, and 75 seconds. I believe it to be a good plan to do this, as we may obtain various planes of detail according to the organs upon which we experiment.

In another case a Parisian surgeon diagnosed a fracture of the radius, while, in reality, there was a separation of the epiphysis of the lower extremity of the ulna. It is true that the immobilization of the wrist was indicated in either case, but radiography demonstrated that, in spite of a well-marked painful spot of the radius, which may have been caused either by the tearing of ligaments or the enormous effusion of blood between the two bones, which was visible even two weeks after the accident, there yet was a possibility of mistaken diagnosis. It is certain that many cases of surgical diagnosis will be changed and corrected with the aid of the x-rays.

The penetration of the x-rays into deeper structures may be obtained nowadays with even very short exposures, and the accidents,—such as burning, erythema, etc.,—become things of the past if we operate with coils of 40, 50, or 60 centimetres of spark-gap and employ strong Crookes tubes. Here is a case in illustration:—

Mr. C., aged 64 years, a farmer, has suffered for several months with bladder trouble, frequent and painful micturition, hæmaturia following walking or riding, dragging pains in the back, and severe abdominal pains during micturition. The patient has never passed any gravel, yet he is an arthritic subject, as he is suffering from general arteriosclerosis. The patient is examined with a sound, but no diagnosis can be made. A large hæmorrhage takes place during the examination. Have we to deal with a new growth in the bladder, varicosities of the neck, or a stone in the bladder? Nothing can be positively affirmed or denied, and we resort to radiography.

The operation appears difficult at first sight, on account of the thickness of tissues to be penetrated, but we are agreeably surprised to

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obtain a clear picture, showing an opaque body behind the ascending branch of the left pubic bone. On the strength of these observations, the patient is anæsthetized and Dr. Aubeau proceeds to crush the calculus, which is of enormous proportions. With the aid of the radiographic picture, the operator has no difficulty whatever in locating the calculus, which is, however, very hard to crush, but the operation is completed satisfactorily and the patient made a good recovery. The calculus was composed of uric-acid crystals.

The stomach has been explored more or less lately, and different experimenters, using different devices, have succeeded in obtaining moderately satisfactory pictures of the stomach. However, I believe that the first complete radiography of the stomach was obtained last December, and I will give as complete a description of it as possible.

G., aged 50, submits to electrical treatment by me for stricture of the stomach, which has been diagnosed by a number of physicians. A hard, circumscribed mass can be felt in the gastric region. When questioned, the patient states that his stomach has given him trouble for a long time; that he has no appetite, and eats hardly anything, using generally nothing but some tea.

He cannot endure the passage of the stomach-tube, and washing of that organ which has been attempted had to be abandoned. It was useless to attempt to make him swallow the little incandescent light by the aid of which I had been able during the last nine years to delineate new growths in a number of cases, and I therefore resolved to try radiography. On the 20th of December I administered about three drachms of bismuth subnitrate, and thirty minutes later I made a radiograph, which, however, did not show anything.

A week later the same quantity of bismuth was administered, and the patient, having eaten more food on this occasion, stated that his stomach felt comfortable. Several pictures were obtained, the first one of which gave the best result. The stomach shows diminution in size; the two sides, being less dark, probably indicate the sclerosed portions. On the left side there appear different strata superposed over one another. The liver shows paler than the stomach, and appears also to be retracted.

Shortly after the sitting the patient had an attack of syncope, and, suspecting a strong neuropathic element in his case, I ascertained from his relations that he had attempted suicide on several occasions by swallowing concentrated solutions of bromide of potassium and laudanum, and that at the same time he strenuously refused food. It is easily

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understood how the patient managed to get his stomach into the state which was revealed by the x-rays. Since then the patient has considerably improved through faradization of the stomach, the appetite is better, more food is taken, and the general condition is very much better. I purpose to take another radiograph shortly.

Little by little, but without any very remarkable progress, medical radiography extends its field of usefulness. By the aid of little devices and slight perfections in the apparatus used we extend our field of observation. The progress is steady and uninterrupted. Gradually each organ of the human system will have to give up its secrets. There are no opaque bodies left. There are no substances which cannot be penetrated more or less easily by the Roentgen ray, and it is simply a question of strength in the apparatus.

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A NEW TREATMENT FOR TUBERCULOUS GLANDS OF THE NECK, WITH A MINIMUM SCAR.

By G. Betton Massey, M.D., Philadelphia.

The recognition of the tuberculous nature of what were formerly known as scrofulous enlargements of the lymphatic glands of the neck has opened a new vista in the treatment of this affection. The disease should no longer be looked upon as a constitutional affection, controllable only by general treatment, but should be understood as a local implantation of the bacillus tuberculosis in an individual whose inherited type of cell is not proof against its germination. In these particular cases the tubercular germs doubtless gain entrance into the lymphatic vessels of the neck through an infection-atrium in the tonsils, and are arrested in the first gland reached by them, there to multiply until the gland is eroded, permitting the next one in the chain to be infected, and so on, throughout the chain.

It is evident that mere constitutional treatment of this condition, while both appropriate and valuable in strengthening the phagocytic powers of the body-cells and fluids, is but a sorry method of reaching an intrenched colony already in vigorous growth. Moreover, these colonies of germ-growth are just beneath the skin, and therefore more accessible than tubercular deposits in the inner organs of the body.

The removal of the infected glands by the ordinary cutting operations of surgery has the disadvantage of leaving unsightly scars, which are seriously objected to by patients for cosmetic reasons. When the capsules of the glands are eroded through, their removal is more difficult, and gives rise to a more extensive scar.

Efforts to cause absorption of these enlargements by the percutaneous application of electricity or by percutaneous cataphoresis, have been equally unsuccessful in my hands; and the reason is evident when we consider that the vital resistance of these germs, though not great, is quite sufficient to resist any agents or influences that are transmissible through an intact skin. When applied to recently by a physician to treat such a case, therefore, I immediately determined to try a modification of my cataphoric method for the destruction of cancer, and, as the application of this modified method was an unqualified success in this case and in that of another case in which it has since been employed, its presentation to the medical profession is now made with much confidence in its value.

The object of the method is the destruction of the vitality of the

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bacilli by the cataphoric diffusion among them of nascent oxychloride of mercury, developed in their midst by the electrolysis of mercury held in contact with a small gold electrode. A small opening is made through the skin and into the gland by a narrow bistoury, under a chloride-of-ethyl spray, and into the opening is thrust a sliver of amalgamated zinc as an anode, not insulated, and 2 or 3 milliampères are turned on for a few minutes to cauterize the tract and keep it patulous for drainage and for the treatment proper. When the whole tract has received a sufficient impregnation with the mixed oxychlorides of zinc and mercury thus developed to keep it patulous for a few days, the zinc electrode is withdrawn and an insulated gold electrode about the caliber of No. 18 wire is inserted, its point being freely amalgamated and made to hold as much mercury as possible. This instrument is left bare for a quarter of an inch from the point only, the remainder being insulated with fused hard rubber. From 2 to 10 milliampères are now turned on for eight or ten minutes, or until all the mercury has been dissipated from the instrument, after which a piece of aseptic lint is placed over the opening, topped by a bit of plaster, and the patient returns at intervals of two or three days for a repetition of the application.

The purpose of the sinus thus formed is the drainage of the products of the dead bacilli and deposited chemicals, as well as for a direct application to the germ-colony. Small doses and the gradual method of treatment are adopted to avoid unnecessary destruction of the gland-tissue, or the production of solid eschars that would not readily drain away, the repeated applications acting in a cumulative way on the protoplasm, finally destroying all morbid germs by the combined effects of the direct action of the germicide and the indirect action of the aroused trophic forces of the surrounding normal cells.

Observation of the two cases to be reported has caused me to believe that the germicidal action is not confined entirely to the gland to which the application is made, but that the chemicals deposited in this situation drain downward to the next glands in the chain and favorably influence any infection in these glands.

The final result is the destruction of the tuberculous bacilli without necessarily destroying all of the gland-tissue untouched by the disease, and when the opening is allowed to close the scar left is a mere point, and the general health of the patient will be found to be improved. The sinus requires no special precautions against septic infection while open, by reason of the powerfully-antiseptic chemicals deposited within and about it.

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CASE I.—Mr. B., aged 27, a stenographer, was referred to me by Dr. E. E. Johnson, of Philadelphia, February 15, 1899. The family history was good. In July, 1898, a tuberculous gland was removed by means of a cutting operation by a physician of York, Pa. The wound failed to heal, and Dr. Johnson cauterized it the following month. When first seen by me there was a large scar on the left side of the neck, near which a tuberculous gland of large size was located. The patient's color was somewhat anæmic.

A small opening was made under chloride-of-ethyl spray, the opening was made patulous by means of the zinc-mercuric anode, and subdermic mercuric cataphoresis was applied by the insulated gold instrument about twice a week, the patient covering the spot between-times with a bit of adhesive plaster and continuing at his usual occupation. In all, eleven applications were made in seven weeks, when the gland itself seemed to be softened and hollow, surrounded by an area of treatment induration. The opening was now allowed to close, subsequent observation showing a progressive shrinkage of the induration.

This patient was last seen August 5th, last, four months after the cessation of the treatment. The induration had disappeared, leaving a minute, round scar in the skin, and the patient appeared to be in robust health.

CASE II.—Miss G., aged 20, also a stenographer, applied for treatment in May last. Her parents are healthy, but there was consumption on both sides in the grandparents' generation, and a sister and brother now have pulmonary tuberculosis. Examination showed two enlarged glands on the right side of the neck, rather alongside of each other than in the same chain. Below these glands there were a number of smaller ones. The patient complained of some stiffness and pain in the neck when tired by the use of the typewriter, and was anæmic and menorrhalgic.

The method above detailed was employed nineteen times to August 22, last, when one gland was shriveled, and it was evident that the glands below were smaller. Treatment was then stopped in this focus of the disease, and she is now under similar treatment for the other gland.

After but a few applications were made the patient noticed that she no longer felt the stiffness and dull ache in the neck upon exertion. She is now in blooming health, and the menorrhalgia has also disappeared.

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DISCUSSION.

DR. NEWMAN: The paper of Dr. Massey is another very important one. There have been going around different reports of cures of tuberculosis by electricity. Dr. Bleyer was sure he could cure any tuberculosis by electrolysis and inhalation, and has written an article, which perhaps Dr. Massey has seen. As to the other reports in the newspapers of the person who was sure that he cured tuberculosis by electricity, it should be recalled that he established a company with president and secretary and agents all over the United States, but he did not tell us how it was done. Now, of course, we cannot go to newspaper reports, but there must be something in this matter, and Dr. Massey's report here is something definite. I would like to ask Dr. Massey to continue his observations and investigate this treatment of tuberculosis by electricity, and if there is anything in it, and it is established that tuberculosis can be treated and cured by electricity, let us be the first ones to go into it, and let Dr. Massey have the honor of being the investigator. I suggested to Dr. Bishop that somebody should be asked to investigate it and bring it before this meeting. That Dr. Massey has cured this glandular tuberculosis there is no doubt. I should ask Dr. Massey to show us, if possible, or to describe the needle that he used. I have not succeeded in curing tuberculosis by electricity. Many years ago I succeeded beautifully in diminishing and apparently temporarily curing a case of tuberculosis, but, if I drove it away from one place, it came back in another, and finally the patient died; and in other cases I have not succeeded. There is no doubt, however, that by electrolysis, by applications directly to the disease, something can be done.

THE CHAIRMAN: I trust that Dr. Massey will honor us next year with a paper more fully describing his method.

DR. NUNN: Before leaving this subject, I would like to draw attention to a little more general application of a principle that it seems to me is involved in Dr. Massey's paper. You will recall the fact that yesterday, when speaking of Dr. Newman's treatment of hypertrophy of the prostate, there was some little discussion as to the effect of a cicatrix being formed there. I then took the liberty of drawing attention to the fact that the cicatrix in a kakoplastic growth was entirely different from a cicatrix in an hypertrophy, and it might rather tend to the cure of that condition. It seems to me that this treatment of Dr. Massey's is now a confirmation of that as a general principle: that is to say, that down in the very centre of the kakoplastic growth Dr. Massey makes an application by the introduction of an instrument, and he leaves there a cicatricial tissue, down to the very centre. But that cicatricial tissue does not interfere at all with the dispersion of the growth, and probably even tends to assist in its dispersion, and afterward we have nothing left. Now, it seems to me that that is the general principle in regard to all those kakoplastic growths, and I think that that paper is applicable in its general application, as well as in the special.

DR. W. T. BISHOP: It strikes me, Mr. President, that if I had occasion, I would not hesitate to use the cataphoric electrode to puncture the lungs, as well as to puncture this outer growth, for you can puncture the lungs with more guarantee to remove it. If I had the opportunity, I would not hesitate

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to try the treatment, and I believe it is more than likely that it would be successful.

DR. SCHEPPEGRELL: I have followed very closely this subject, and I believe that Dr. Massey can readily claim priority in the treatment of tuberculous glands by the cataphoric action of electricity. Electricity has, as Dr. Newman says, been used in the treatment of tuberculosis; but this is the first time that a definite, physical procedure has been described that commends itself in the treatment of tuberculosis. When it comes to the local treatment in the throat, I three years ago submitted to the American Laryngological Society the treatment of faucial tuberculosis by cataphoresis, with which Dr. Massey is familiar. I used, in that case, copper instead of mercury. I presume Dr. Massey has his reason for preferring mercury, but I tried various articles,—sulphur among others, iodine, etc.,—and my best results were obtained by pure copper—not from copper obtained by electrical action. The sphere of copper was applied directly to the tuberculous area of the larynx and the oxychloride of copper was deposited directly in the diseased tissues, acting, by its germicidal effect, directly on the bacillus, and by its stimulating effect on the tissues. I have had some very good results. Two cases that were considered absolutely hopeless I succeeded in entirely curing, and had more or less success in other cases.

In these cases we had used lactic acid, but that acts only superficially. It is applied to the diseased area, and destroys the tissue just as well; but here, in this deposit of copper, we can make the deposit so mild that it will not injure the tissue, and yet destroys the bacillus.

As regards this application to tubercular glands, I shall, when I return, try it in a number of cases, and, I hope, with success. I would like to ask Dr. Massey, however, if he has tried other material except the mercury. I will also submit this: one of the objects in treating by electricity instead of by the ordinary surgical methods is to avoid a scar. I know that ladies particularly object to the scar that results from a surgical operation about the neck or face; and if you can, in any way, minimize it, as Dr. Massey says, it will be very valuable. And the question is whether, instead of employing the zinc electrode to make a patulous canal, you could introduce the mercury hypodermically, insulating down to the gland, so that we shall have the cataphoric effect just within the glands, and not on the surface, and when the instrument is withdrawn you can easily seal up the opening, without maintaining an open wound. Of course, this is a matter for investigation, and Dr. Massey deserves the credit of being a pioneer in this department. The question is whether you can not only minimize the scar, but avoid it entirely.

DR. CLEAVES: I have been very much interested in listening to the paper read by Dr. Massey. I have tried cataphoresis in these glands, but used copper by electrolysis, instead of the mercury, introducing a copper needle into the gland. I used 2 or 3 milliampères. The glands healed up and I got rid of all indurations, and when I last heard from the patient there had been no further return of the tubercular trouble. That is the only opportunity that I have had personally to treat tubercular glands. I believe that Gautier and some other of our French friends (whose reports we are apt to take *cum grano salis*) have been treating tubercular glands without scar by electrolysis. When we

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bear in mind the amount of salts liberated by this action and deposited within the tissue, and knowing, from the nature of these salts, that they are powerful antiseptics and astringents, we must be prepared to get results of some sort; and I will not hesitate at any time to treat tuberculous glands either with the mercury or with the copper salts. As to scar-tissue, I think we should remember the radical experiments made by Gautier in 1891, who showed that the indurations made by the action of the positive pole were but temporary. I have the record of hundreds of cases of cataphoresis by either copper, zinc, or zinc amalgamated with mercury, and some by iron as well, in all sorts of conditions, and I never yet have seen the slightest evidence of a scar when we utilized the chemical action on the metal at the positive pole. That is one great advantage of cataphoresis over the galvanic application direct, for, with the galvanic current applied with a non-oxidizable electrode, either negative or positive, we are sure to have scarred tissues, according to the current that is used. But when the chemical action is employed in diffusing metal, there is absolutely no destructive action at all. I have never had any unpleasant reactionary symptoms.

DR. MASSEY: Mr. President, I feel gratified at the reception of my paper, and I feel, too, particularly gratified at the expressed idea that here is a new adaptation of a possibly old thought. The only thing that is absolutely mine in this method is the cataphoresis of mercury. Metallic cataphoresis, of course, has been used by many for a long while, and has not been used nearly as much as it should have been. But, in mercury, when changed by the electrolytic action into an oxychloride, you have the most powerful antiseptic, the most powerful germicide known to the medical world. It shares with the other oxychlorides a death-dealing action to protoplasm, particularly the protoplasm of germs, but it is far more effective than they, and has greater rapidity of action. The very name of mercury, "the fleet-footed metal," indicates its fleetness as a cataphoric agent, for we must not forget that the speed of an atom propelled by a current varies with the atom, and that this speed has a relation to its atomic weight. For instance, it is known that hydrogen flows faster by cataphoresis than anything else. Now I can well conceive, though I do not know, that mercury goes faster than other metals; that is, it requires less current than other metals to disseminate it an equal distance. Another advantage of mercury from a gold electrode, in the subdermic application, is also its lack of coloring. One using copper would stand a chance of coloring the skin; and though that would not be an objection to internal application, it would be to any dermic or subdermic application. The use of zinc, or zinc-mercury, is first employed in order to make a patulous canal. That might have been done with gold, but I am quite sure that oxychloride of zinc is more destructive to both healthy and unhealthy tissue than anything else. Two milliampères, concentrated on the point of a small sliver of zinc, will quickly cauterize and leave an opening. This sliver or needle of zinc is simply a piece of stove zinc,—the kind of zinc that is put under stoves,—cut out with a pair of scissors. It should be cut fresh for each case, because zinc becomes brittle and liable to break after use with mercury. The conductor is a piece of fine magnet-wire, which is attached by wrapping it around the large end of the zinc, bending the latter, and mashing it down with a pair of pliers. This electrode is not

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insulated, but simply freely amalgamated, and always passed through the flame of a lamp, on the general principle of antisepsis. Although the cataphoresis is antiseptic, it is best to reinforce antisepsis with asepsis. The puncture, by the way, may be made with as small a bistoury as a 2-inch straight Hagedorn needle. The canal having been made patulous, we remove the zinc electrode and replace it with the amalgamated gold one. This consists of a gold, blunt-pointed wire with suitable attachment, and is insulated to a point about a quarter of an inch from the end, the insulation preferably consisting of fused hard rubber. The insulation has to be freshly fused each time that it is used, as all such slight coatings are brittle. The bare portion is thoroughly amalgamated with mercury each time. Ten milliampères in five minutes would hardly clear this amount of mercury off the gold.

Dr. Scheppegrell has asked: why not make these applications without a scar; that is, seal them up at once? The reason that I have not done this is because much more current would be required to do this work at one application, risking the production of a subdermic eschar. By keeping the canal open, repeated use of smaller doses have the same effect. It might be done at once, but I had not thought it could be. After all, we have not yet found how little this scar can be by this method—surely no greater than required in the removal of a superfluous hair.

Dr. Bishop has brought up a wider field. In another paper, where I spoke of the possibilities of gold-mercury cataphoresis in cancer, I made the statement that the method would cure tuberculosis in any part of the body excepting within the skull, the thorax, or the abdomen. As Dr. Bishop says, it is even possible that those limitations may not be limitations; that it might be possible to inject the lung with mercury and perform a major application. It would require what we would call a major application to destroy a germ-colony of the usual size in the lung—something in the neighborhood of 50 milliampères or more. To do that, we must have some means of supplying a sufficient amount of mercury to the seat of the puncture, which could easily be done. I am obliged for your attention.

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ELECTRICITY IN THE TREATMENT OF DILATATION OF THE STOMACH.

By John A. Lichty, M.Ph., M.D., Pittsburgh, Pa.

The dilatation of the stomach which is to be considered in this paper, with reference to treatment by electricity, is that form usually specified as *atonic dilatation*. It includes the first and second divisions of dilatation specified by Riegel and Boas, namely: 1. Simple gastric atony, or motor insufficiency without dilatation. 2. Atonic dilatation without pyloric stenosis.

Too much cannot be said of the necessity for considering the etiology of atonic dilatation when referring to the treatment of such a condition. Nor can too much emphasis be placed upon the absolute necessity for considering atonic dilatation as a symptom, belonging to a symptom-complex, which reflects an existing disease. The limitations of the subject at hand, however, do not warrant the consideration of the etiology of atonic dilatation.

In a paper read before the Ontario County Medical Society of New York, and published in the *International Medical Magazine* of April, 1899, the writer has considered this subject with special reference to etiology and treatment. In that paper the treatment of dilatation of the stomach was presented under four heads: hygienic, dietetic, physical, and therapeutic. The physical treatment included, among other methods, electricity. It is not intended, in the present paper, to advocate the use of electricity in the treatment of atonic dilatation to the exclusion of other measures or methods, but to consider more fully its indications and modes of application.

In cases of atonic dilatation of the stomach, there is not only to be considered the actually dilated stomach, because there is often associated with it a fault in the secretions of the stomach, an hyperchlorhydria, an hypochlorhydria, or an achylia. There is a peculiar sensation experienced by the patient, described by one as a pain in the region of the stomach, by another as an irritation, and by another as something indescribable, which makes him desperately miserable. There is a relaxed condition of the abdominal walls, and a flabbiness of the muscles of the body generally, but of the abdominal muscles particularly. There is an absence of the normal fat which surrounds the abdominal organs, due to poor nutrition, lack of assimilation, or at least to some fault of the digestive system. There may be, conse-

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quently, a nephroptosis, or a gastroptosis, or a general splanchnoptosis. These conditions constitute the indications for electricity in the treatment of atonic dilatation of the stomach, and, according as one or the other predominates, the particular current and method of application are determined.

If, upon examination of the gastric contents after an Ewald test-meal, the secretion of gastric juice is found normal, or nearly so, and there is a relaxed condition of the abdominal walls associated with the dilatation and atony of the stomach, the faradic current is selected. The current should be a slowly-interrupted one applied fifteen minutes daily, or on alternate days. A large electrode, six by eight inches, is placed on the back about the region of the tenth dorsal vertebra, and a smaller electrode is moved over the abdomen during half of the *séance* and the remainder of the time allowed to remain stabile over the exact position of the stomach. Whether the anode or the cathode is placed over the stomach is, to my mind, immaterial.

If, on the other hand, there is an abnormal secretion of the gastric juice, an hyperchlorhydria, hypochlorhydria, or an achylia, and especially if it is associated with pain or distress in the stomach, the galvanic current is selected. The current should be a mild, continuous one, from 5 to 15 milliampères, applied ten or fifteen minutes daily, or on alternate days. An electrode, six by eight inches, is placed on the back about the region of the tenth dorsal vertebra, and a larger one, sufficient to completely cover the stomach, is placed on the abdomen. I usually connect the cathode to the electrode on the back and the anode to the one over the stomach. Whether it is necessary to make this distinction of the poles I do not undertake to say. Relief from pain is sometimes immediate after such a treatment.

If these cases of disturbed secretion and gastric pain or distress are associated with relaxed abdominal walls, the galvanic and faradic currents may be applied alternately; or during the same *séance* the faradic current may be applied for the first eight minutes, and the galvanic for the subsequent five or seven minutes.

We are indebted to Dr. Einhorn, of New York, for the perfection of a method whereby the stomach can be directly electrized. The intragastric electrode has its indications and limitations. There is no doubt that the anticipation of those who first employed this electrode and advocated its use have not been wholly realized. It

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was claimed that with this electrode the walls of the stomach could be made to contract at will, and that by doing this such a tone of the muscles of the stomach could be brought about that it would resume its normal size and position. Physiologists were quick to take up this idea, and soon showed that, so far as could be determined, the physical phenomena produced by the intragastric electrode were not at all different from those produced by applying the electricity percutaneously. In other words, that neither the direct nor the percutaneous electrizations of the stomach cause any visible contractions or spasm of that organ. It must accordingly be concluded that the therapeutic results which are so evident in the treatment of atonic dilatation by electricity must be due to other causes than that of producing momentary contractions or spasms of the walls of the stomach.

It is well known that electricity, applied properly, will increase the tone of muscles and stimulate nutrition; and these are the exact conditions which it is necessary to bring about in dilatation of the stomach. The relaxed abdominal walls must be developed and the scaphoid abdomen must recover its normal fat-tissue.

The former condition—*i.e.*, that of increasing the tone and strength of the abdominal walls—can certainly be accomplished more easily, with greater comfort to the patient, and with greater safety, by using the percutaneous method as previously described. The latter—*i.e.*, that of improving nutrition and hastening the deposition of fat in the abdomen—*may* be accomplished more readily by using the direct method, providing the patient swallows the electrode without dread or difficulty. There is no doubt in my mind, however, that the same improvement in nutrition can be brought about, perhaps not so quickly, by using the percutaneous method. I have used, and am using, both methods, choosing the direct in some and the percutaneous in others, and in still others using them interchangeably. I fail to see any decided advantage in the direct over the percutaneous, except that, where the condition is associated with considerable gastric pain and distress, the direct application seems to afford more instant relief. I can give no better directions for the application of the intragastric electrode than those given by Einhorn in his book on "Diseases of the Stomach." It seems to me necessary, however, to warn physicians against a too promiscuous use of this electrode.

Several years ago I was called in consultation to see a patient

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who was suffering from some disease of the stomach. The most prominent symptom presented by the patient was that he had been unable to swallow solid food for some time, and for a short time it had been difficult to swallow liquids. Upon inquiring into his history, I found that he had been treated for dilatation of the stomach, and that an intragastric electrode had been used for some time, within the year previous to the consultation. I also learned that upon removing the electrode it was always covered with blood, and was usually followed by regurgitation of blood from the stomach. The consultation resulted in a diagnosis of obstruction at the œsophageal opening of the stomach, probably of a malignant nature. Surgical interference was advised, with the idea of establishing a gastric fistula. The advice was finally followed, and a malignant constriction of the œsophagus at its opening into the stomach was found. The patient lived some months after the operation, but finally died from a general carcinomatosis. I cannot but feel that the instrumentation, which the use of the intragastric electrode entailed, was a positive injury to this patient. Besides, the stomach was found only moderately dilated.

Unless the exact condition of the stomach is known, such mistakes will be sure to occur; hence in cases of doubt I consider it much safer to follow the percutaneous method.

The results obtained by the use of electricity, as described above, are so evident that it seems unnecessary to report any cases. Moreover, in the treatment of atonic dilatation of the stomach other measures are prescribed in conjunction with electricity, such as proper diet, rest and freedom from care, proper hygiene, and therapeutic measures; and it would be difficult in any one case to specify what percentage of the cure could be ascribed to electricity alone. At the same time it is no exaggeration to say that, after the diet has been corrected, there is no more important agent to be employed in bringing these patients back to health than electricity.

DISCUSSION.

DR. MASSEY: There are some very important points in this paper that are borne out by my own experience. I have had several cases in which either an intragastric electrical application or the mere use of the tube was insupportable, the patients claiming that harm had been done by a previous attendant in this way. I, of course, could not corroborate such results. It was evident that an atonic, contracted stomach with hypopepsia had been mistaken for dilatation. As to carcinoma, I hardly think that could have been caused

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by the use of the intragastric electrode. The use of the electrode was clearly unwise in the presence of the carcinomatous growth. These cases of so-called nervous dyspepsia, in which one may at times diagnose a gastric contraction, are really forms of what might be called hysteria of the sympathetic nerve. In such cases the external application of electricity is just as wise, and, in two or three cases that I recall, ultimately cured the patient, after an infinite amount of suffering from intragastric applications of various kinds. Now, the use of the intragastric electrode that suggests itself to my experience as most valuable is where we are sure of gastric dilatation; and the methods of ascertaining that dilatation exists at the present time are so moderately easy of application that one need not err.

DR. SCHEPPEGRELL: The danger of passing an electrode through the œsophagus is, of course, very marked in cases in which the walls have been weakened by ulceration or malignant disease. Not only in these conditions, but in any case, there is danger in passing an electrode for sounding the œsophagus,—not only danger of having an unpleasant effect, but there are several cases on record in which the passing of an electrode into the stomach has been followed by fatal results. There was a case of a friend of mine in Pittsburgh, —I cannot recall his name at this moment,—a case in which there was a nervous, hysterical condition, in which the passage of the tube was followed by a fatal effect. As regards the utility of percutaneous applications in such cases, the question arises: how much of the current, particularly of the galvanic, with its low tension, would pass through the stomach when applied to the abdominal walls. That is a question to be decided. It may be that a great deal of this effect is due to the general tonic action on the system generally; but how much of this current passes through the stomach, and how much through the surrounding tissues, is the question.

DR. NUNN: Mr. President, there is one important omission in this paper, which it seems to me is a common characteristic of many of the papers that are read here, and that is the omission of the name of the polarity. Now, I really cannot understand, for one, how it can be unimportant which pole is used. I am very well aware that a good many hold to the idea that, in the faradic current, it is quite unimportant as to polarity. If there is such a thing as polarity at all in these currents, by all means it is important. If we are to understand that there is a difference in the action of the two poles, it is certainly important which one shall be placed in a given place, and which one shall be placed in another. Either polarity exists or it does not exist. If it exists in the large current, it does in the small current. If it has an effect in one current, it has in the other. And, when it comes to the scientific statement, it is, to my mind, quite important that we should determine the use of the polarity; and to say that it is immaterial is, to my mind, fallacious.

DR. CLEAVES: I simply wish to add my voice to what Dr. Nunn has said. I think polarity is of great importance, and none of us should ever present a paper without saying what pole was used, and making it clear why it was used. It is the only way that we ever do scientific work.

DR. ROCKWELL: I do not quite agree with the author of the paper, or with Dr. Massey, in regard to the effect of intragastric applications in gastric

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affections. I have had a large experience in these cases, and I have not found that I could get as good results from percutaneous applications. The current diffuses so rapidly that it is almost impossible to get any effect upon the stomach with any percutaneous current that will not be injurious to the patient, so far as the contractions of the organ are concerned. So I am accustomed, in this class of cases, to use internal applications. The electrode of Einhorn is a very good thing; but when I heard of Dr. Einhorn and his electrode, and the remarkable results he got from it, I smiled, because he put one electrode in the stomach and held the other in the hand. That is utterly absurd, because there could be no appreciable results from the electrical current in the stomach with a current that one could hold in the hand. I have written something about this thing in national magazines, and illustrated there electrodes that I used. I used a bipolar electrode. It is held in the stomach. I have never seen any ill effect from the electricity directed to the stomach. In all these cases I feel that I can get better results, by far, by the internal application to the stomach by means of bipolar electrodes.

DR. MASSEY: I am not quite as opposed to the intragastric electrode as the doctor seemed to state. In the cases that I referred to there was no gastric dilatation.

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ELECTROTHERAPY.

By Dr. W. S. Watson,

Proprietor of Riverview Sanitarium, Fishkill-on-Hudson, New York.

The object of my paper is to emphasize the need of more confidence in electricity as a therapeutic means.

The prevalent opposition to modern electro-therapeutics has been largely due to the imperfect methods, or means of application, in the past. Many who have ignored it, or who have discredited it after having employed it according to plans of ten or twenty years ago, are not cognizant of the advances that have been made in the time named. Electricity is still referred to by many, in a patronizing way, as a palliative; that its influence is more psychical than otherwise. The opponents who make this class of charges see no good in anything they do not understand. Electro-therapeutics has won an exalted position in the eyes of all save a few; obstructionists are rapidly disappearing. To deny the value of electricity as a therapeutic means because of failures would be to say that medicine never fails, which everyone knows is not true. Failures may be due to various causes: they may be due to faulty apparatus; to an imperfect understanding of the technique of application in certain conditions; or it may be that too much has been claimed under given conditions. The same has been true of many of our drugs. If we oppose every new idea by denying its utility, we obstruct progress and certainly cease to be scientific workers.

Some one has divided our opponents into three classes: Those who openly oppose; those who believe it capable of curing every ill that flesh is heir to, and those who profess not to believe in it, but use it to please their patients. The man who claims it as a cure-all is its worst enemy. It is not my intention to go into an extended discussion of the various forms of electrical currents that are in use; it is my purpose, in as practical a manner as I am capable of, to present some reason for my faith, as well as cite some of the beneficial effects of the various forms of electricity commonly in use.

We have been using electricity as a therapeutic means for the past twenty-five years; static electricity has been used daily for the past six years in the institution, in various ways and under varied

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conditions. We feel warranted in saying its field of usefulness is sufficiently broad to justify the saying that it is wonderful for good.

Static electricity is not a cure-all, by any means. Its chief field of usefulness is in defective nerve-action; in a feeble circulation; faulty nutrition; forms of neuritis; rheumatic contractions; infiltrations and exudations about the joints; or feeble heart-action of a functional character, attended with cold extremities. Its action is certainly phenomenal in equalizing the circulation and in bettering the nutrition.

In locomotor ataxia the static current has proved a valuable agent in retarding the degenerative changes of the cord and in relieving the attendant pains; in fact, the frequent use of the long-drawn spark keeps the ataxic passably comfortable. The usually attendant muscular atrophy can be largely prevented by the daily use of the long spark applied to the muscles that so rapidly waste when such means are not resorted to.

A case in illustration of functional heart disturbances:—

A Mr. W. came to see me, suffering, as he had been told, with threatened heart-failure. He was very much troubled with dyspnœa, palpitation, and vertigo, and pains in both parietal regions, which disturbances unfitted him for his usual duties. The man was of a full plethoric habit—just such a man as one would expect to see drop from apoplexy. Upon examination I found no evidence of an organic trouble, or other lesion of the heart, and that his trouble was entirely functional. The disturbed heart-action I found to be due to an accumulation of gas in the stomach, and that due to a disturbance of the portal circulation and an excess of uric acid in the system: conditions that are amenable to the static currents.

The patient, weighing two hundred pounds, was placed upon the insulated platform, and treatment begun by giving him static insulation for ten minutes of a positive character, followed by a static breeze up and down the spine and to both temporal regions, with long-drawn sparks in the hypochondriac region.

After the first treatment the shortness of breath partly disappeared, his cold extremities became warm, and the attacks of palpitation were less marked; after the third treatment he felt like a new man, and was able to walk off at a brisk pace, experiencing none of the feeling of dyspnœa that had so alarmed him.

The treatment was continued on alternate days for a period of three weeks, when he was discharged without any remaining evi-

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dences of biliary disturbances or excess of uric acid, the quantity of urine eliminated being largely increased after the second treatment.

There is, we think, no question as to the value of the high-tension or high-frequency currents under such circumstances. If we are enabled, by the use of the static current, to produce such an impression upon the human system as to increase the circulation and can do so by so natural a means as electricity, we will certainly get an increase of metabolism without endangering or disturbing any other function.

It has often been hinted by designing, disbelieving physicians that static electricity was of no real value, the apparent good that followed being imaginary. Our experience in the use of the influence machine has been such in the past ten years that we cannot see how anyone can possibly question its utility. We have used it in hundreds of cases of neuralgias, rheumatic pains in various parts of the body, with such perfect and lasting relief that we are positive of its value. The positive and powerful revulsive effect brought about by the long-drawn spark when taken from the spine ought to be convincing, we think, to anyone. The spark, when given along the spine, causes dilatation of the peripheral vessels; the circulation is at once increased, and the patient soon breaks out in a free perspiration. Unquestionably, we ought to expect beneficial results from so powerful an agent, when judiciously used.

Galvanism possesses great efficiency in various forms of congestive troubles, especially in the congestive conditions met in many of our mental disorders. There is no question, we think, as to the possibility of securing tonic contractions of the cerebral vessels that have been habitually dilated by the use of the galvanic current if used daily through the brain. Long-continued hyperæmia of the brain and cord must sooner or later end in psychical disturbances of varied types. Galvanism is the only current, to our mind, that has any direct influence upon the intracranial organs, and galvanism generally acts promptly and effectually. Strong currents should not be used. We do not believe it is wise, nor is it necessary, to use more than 2 or 3 milliampères; results are secured by slow interruptions, and frequently repeated. While we find the more modern forms of electricity—viz.: sinusoidal, high-tension, and static currents—are highly pleasing in their effects, it is not well to lose sight of the well-established value of a pure galvanic current.

Dr. J. Althaus has recently announced his belief in the specific

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action of electricity upon the neurons, and the benefit of the constant current in premature senility, also of galvanism in arresting arteriosclerosis. He expresses the belief that by the skillful use of electricity we may turn back the course of senility five or ten years. His experience is such in the use of electricity that he believes that by the daily use of galvanism men of sixty-five may be kept active until eighty or ninety. Such conclusions are certainly very pleasing to many of us who are rapidly approaching that period of life, coming, as it does, from one with so high an electro-therapeutic reputation as Dr. Althaus.

Metallic Electrolysis.

The advantages of electrolysis over the old methods of topical applications of iodine, nitrate of silver, etc., is so great that we feel it scarcely necessary to make a comparison. You all know how difficult it is to get such remedies where we want them, and how quickly they are thrown off by the secretions in the treatment of uterine catarrhal troubles. Not so by metallic electrolysis; the action can be localized and the medicinal action kept just where we want it: on the surface or driven into the tissues by cataphoresis.

Metallic electrolysis depends upon the electro-chemical decomposition of the metal employed as the active electrode, which must be of an electro-chemical destructive character and attached to the positive pole, where the oxygen, chlorine, and acids assemble under the electrical action; while the reverse would follow if the negative was the active pole. Alkalies would concentrate at the latter pole, and destruction of tissues would follow if strong currents were employed.

A copper electrode, when properly applied, and in connection with the positive pole of a galvanic current, liberates, as is well known, by electro-chemical action, oxychloride of copper, or of zinc if a zinc element should be used.

Positive electrolysis and negative electrolysis are results that must be understood before one attempts to make use of electrolytic action upon living tissues.

It is important to remember that the positive pole produces contraction of tissues and coagulation; hence a copper electrode introduced into the uterine cavity we have found superior to all other means in hæmorrhages due to relaxed, ulcerative, boggy conditions, and where there are vascular vegetations. The oxychloride of cop-

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per is liberated upon and into the tissues, in proportion to the current strength and duration, by reason of the electro-chemical action. Oxychloride of copper is, as you know, a styptic and antiseptic; the oxychloride of zinc is a more active caustic.

There is no means, to our mind, so sure and easy of use as metallic electrolysis in hæmorrhagic metritis due to imperfect subinvolution or to vegetative hypertrophy of the mucous membrane. I have never failed to get gratifying results by use of the positive pole of the galvanic current, using a pure-copper electrode, somewhat after the method of Apostoli. Cervical ulcerations are successfully treated by the use of one or the other of the poles. For a softening caustic effect, use the negative pole and pure zinc.

The Static Cage.

The static cage is a device for the production of ozone, in which the patient sits upon an insulated platform, with a wire cage around him and extending above his head. The patient is connected by reason of his chair being upon a metallic base, which is, in turn, connected to the positive side of the influence machine. The cage acts as a condenser, impeding the rapid escape of the overflow-current volume from the patient. The open meshes or spaces between the wires break up the current (which is of a vibratory character) in its attempt to escape; the bombardment produces free ozone. The only difficulty I experienced in the use of the cage for the production of ozone is in damp weather, when little or no ozone is produced.

The beneficial effects of ozone are too well known for me to elaborate upon. The ozone-bath is found valuable in anæmic conditions, chlorosis, and all conditions of blood-impoverishment.

The Electric Light.

My increased faith causes me to repeat part of what I have said before this society some years ago on the value of the electric light.

Our experience, covering a period of many years of sanitarium work, proves to us the unquestionable vitalizing character of the electric rays. Many experiments have been made of the influence of the electric rays upon plant-life.

At Cornell University, and elsewhere, it has been shown that various fruits ripen with as fine a flavor, and quicker under the influence of a powerful electric light, than in the sun's rays; hence

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we feel it reasonable to assume, since such is a demonstrable fact, that beneficial results may be expected to follow the exposure of the person to a strong electric light. We are firm in the belief that each ray of light emanating from the sun, or other electric source, differing in color as they do, possesses, in some degree, certain therapeutic qualities peculiar to itself. We have daily demonstrated the action of light upon the peripheral circulation. The free induction of perspiration at a temperature but little, if any, above the normal bodily temperature is to us an indisputable evidence of an energy at work other than heat in the ordinary sense, viz.: by radiation or convection. It is not uncommon to place a patient in our electrical room, the interior temperature not being above eighty degrees, when evidences of increased capillary action will be apparent, together with perspiration upon the skin, before the temperature of the room has attained that of the normal bodily temperature.

DISCUSSION.

DR. MASSEY: Mr. President, I am sure we all agree that the paper read is a very excellent account of many of the truths of electro-therapeutics—truths that cannot be mentioned too often at the present day, particularly when, though we ourselves are informed, the profession yet thinks of electricity as only a means of excitation of nerve and of muscle. Its greater fields cannot be gone over too frequently. But, in a body like this, we should also encourage criticisms of technique. It occurred to me, during the reading of the paper, that there is one little point in the use of the cage to which I would take exception, and that is the fact that the patient sits on a metallic plate, instead of holding the chain in the hand. I believe that this is a rather usual way, but it has always seemed to me that it would be better to place the patient in direct contact with the negative pole by holding the chain in the hand. This is a painless method, whereas if you sit with the feet making contact the current is apt to go up through the nails in your boots, and there will be little sparks at times.

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ELECTRICITY IN DISEASES OF THE NOSE, THROAT, AND EAR.

By W. Scheppegrell, A.M., M.D.,

President of the Western Ophthalmologic and Oto-laryngologic Association, etc., New Orleans.

The application of electricity, which has been found so useful in medicine and surgery generally, has not been entirely neglected in the special department of ear, nose, and throat diseases, and appliances more or less complete for its application may now be found in the office of every advanced laryngologist and otologist.

The use of electricity in diseases of the nose, throat, and ear, not only in the treatment, but also in the diagnosis and prognosis, has now become so extensive and varied that the limits of this communication will permit hardly more than a general survey over the field of electro-therapeutic progress. It is hoped, however, that this will not be without its points of interest to the members present.

As an illuminating agent, electricity still holds its own in this department in spite of the Welsbach, acetyline, and other lights that have been recommended. The yellowish light of the incandescent lamp does not give the natural coloring to the mucous membrane as is the case with the Welsbach and other white lights; our judgment of things in general, however, is always relative, and we soon become accustomed to the abnormal coloring, and, in fact, do not realize it until we compare it with the appearance presented by the sunlight or the Welsbach burner. For the smaller lamp used in examining the accessory cavities, the incandescent lamp has not been replaced.

Of the greatest value in rhinology and laryngology is the application of electrical energy as a cauterizing agent. For reducing hypertrophies and destroying tumors, the application of the electrocautery within the nose and throat is admirable. The instruments for applying the caustic effects may be carried harmless to the various parts of the nose and throat, and the application, completely under the control of the operator, may be commenced and ended at pleasure. When the chemical cauteries are used, in addition to the danger of applying them to parts for which they are not intended, it is difficult to limit the cauterizing effects, as the chemical com-

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binations, which are started by the application of the chemical agent, continue for some time after the operation and cannot always be stopped even by the application of a neutralizing agent. With the electrocautery this is not the case; the action is commenced when the current is admitted and ceases when the circuit is broken.

The application of the galvanic and faradic currents has not been developed in this department to the extent the importance of the process demands. In view, however, of the greater conservatism which is now manifested, this will probably come into more prominence in the near future. It is certain, however, that the subject will prove a fruitful field for further development.

I do not refer here to the application of the galvanic and faradic currents in the treatment of paralytic and hypokinetic conditions of the muscles of the throat, as its value in this connection has been fully recognized. Nor to its use in goitre and Basedow's disease, in which electro-therapeusis is admitted to be of value. I refer more especially to their use in influencing vascular changes and correcting pathological conditions in the nose and throat, in which electro-therapeutics is probably of great value, but in which it has been thus far but little used.

While the limits of this communication will not permit me to go into details in this connection, I cannot but call attention to the value of galvanism in the treatment of so-called catarrhal affections. Not only is it founded on the most conservative principles, but has given results which already give evidence of its efficacy and compare favorably with other procedures, this being high praise when we consider that the subject of scientific electro-physics and electro-therapeutics is almost a *terra incognita* to the majority of physicians.

This valuable method of treatment is applicable in what appears at first sight to be opposite conditions. Its stimulating effects in atrophic conditions, such as ozæna, is so marked that when properly applied I consider it of more value than all other methods of treatment, excepting cupric electrolysis, which, also founded on the application of electricity, adds the germicidal effects of the cupric salts to the stimulating effect of the application.

In congested conditions of the mucous membrane of the nose, which is probably present more frequently than all other pathological conditions, a mild galvanic application stimulates the circulation by its tonic effects on the vasomotor nerves, and, unlike the effects of the electrocautery, is followed by a return to the normal

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condition without being dependent on cicatricial tissue for restoring the normal patulency of the nostril.

The principle of the application of galvanism and faradism in paralysis is so similar in this region to that observed in other parts of the body that it will be necessary here only to allude to its value in this connection.

Cataphoresis has been used in the treatment of goitre with fairly satisfactory results, although it still leaves much to be desired. It is useful in applying cocaine to the ear for its local anæsthetic effect. I have for some time also applied it in the treatment of sclerotic conditions of the middle ear, but my cases thus far have not been sufficient to justify my formulating any conclusions as to its therapeutic effect.

Electrolysis has been used in cases of fibroid tumors of the nose and throat, and has been considered by some to be superior to all other methods, as the great disposition to recurrence appears to be diminished in this means. Although but little used, electrolysis is an excellent substitute for the electrocautery in hypertrophies and other conditions for which the latter is used almost exclusively.

Several investigators have experimented in the application of galvanism to the auditory nerve for its diagnostic as well as for its therapeutic effect. The results have been by no means harmonious, although those who have had the greater experience in the application of electro-therapeutics believe it to be of value. The reaction of the acoustic nerve to electrical excitation was first investigated in a scientific manner by Brenner and afterward by Neftel, and more recently Gradenigo has followed up this line of research. This subject, however, is still in an embryonic condition; hence the incompleteness of electro-therapeutic methods in affections involving the auditory nerve or the internal ear. This subject presents a field which has been much neglected, but which will probably reward the intelligent research of men whose scientific training as well as medical knowledge has fitted them for this line of investigation.

Electricity affords a useful form of energy for operating various mechanical appliances used in the treatment of diseases of the nose, throat, and ear. This refers especially to vibratory massage and pneumomassage, which have recently received considerable attention. In the treatment of diseases of the nose vibratory massage is a useful substitute for the more heroic methods used, and electricity has so much facilitated its application that it is now rarely used

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otherwise, especially on this side of the Atlantic. Pneumomassage is also a useful adjunct to the method of treating certain ear diseases, and, while it will probably not fulfill the expectations of its most sanguine advocates, has given undoubted good results when used within its proper limitations. Here also electrical energy has facilitated the method and made its application more exact.

Thus far, electricity—in the department of the nose, throat, and ear diseases—has been used chiefly for its simplest effects, such as the cautery and illumination, both of which may be used with little or no knowledge of the principles of electro-physics and electro-therapeutics. Even here, ignorance of the most elementary knowledge of the subject has placed many a physician in an embarrassing position. The methods which require a thorough understanding of the laws of electro-physics have been applied within narrow limits only, and they have even been condemned by physicians whose experience has given them absolutely no opportunity for judging of their value. It is to be hoped that some portion of the longer period of study, which is now obligatory in all the advanced medical colleges, will be applied in teaching the principles of electro-therapeutics so that the time will soon come when it will be given more attention, and so many physicians will be interested in the subject that it will receive the prominence which it deserves.

DISCUSSION.

DR. GIBSON: Mr. President, I have been very much interested in the reading of Dr. Scheppegrell's paper, having been experimenting a little in the last few months along those lines, and I must confess that I have been very favorably impressed with my efforts. The doctor mentioned the use of electricity in hypertrophy of the turbinals. Along that line most of my work has been done, and I have been very much pleased. It is really very gratifying to see the results—to have patients come to you with an hypertrophied turbinal almost to a point where but little air will pass, and obtain relief without any cautery effects at all; merely 2 or 3 milliampères of current. I have not been able to decide which pole is best,—negative or positive. Both seem to relieve the patient, as I say, in a few minutes. It is quite remarkable to see how the hypertrophy will become absorbed, and how much more air the patient can obtain through the nose from that side. Also I find that I may make a combination of electricity with albolene sprays, spraying, in the usual way, with some antiseptic fluid, then using electrolysis, and ending with a coarse spray of albolene, which is always very gratifying to patients in this condition, especially in cases of acute or subacute rhinitis. Sometimes I have tried electricity one day, and these sprays another, but it is not successful, and every patient that I have used electricity upon expressed a preference, in almost

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every case, for electricity. He is much more relieved, and is relieved for a greater length of time after the electrical treatment than after the spray, and I have been very much gratified in the results in nose and throat work. I have also experimented somewhat in the treatment of the Eustachian tube, having one pole over the nose and the other over the ear. I think I shall be able to reach the inflammatory conditions, acute and chronic, and shall be able to do a great deal of good in Eustachian trouble and also in ear diseases by this treatment. In fact, like Dr. Scheppegrell, I believe that electricity, thoroughly and scientifically applied, is going to work wonders, and be a remedy, *par excellence*, in almost all inflammatory conditions of the air-passages of the nose and throat.

DR. CLEAVES: I have been extremely interested in the paper read by Dr. Scheppegrell. I know from quite an extensive clinical experience in nose and throat conditions that we have, in the application of electricity, an agency that combats successfully very many of these conditions. Personally, in the treatment of hypertrophied turbinals I have found it of great value. In nasal trouble and in the thickening of the drum I have applied it with very good results. In enlarged tonsils electrolysis is also found to be very useful, without any destructive action. It is better to have the tonsil scarred than utterly destroyed. It is very much slower than to use the thermocautery, but the ultimate result is very much more satisfactory. In all the other conditions secondary to catarrhal trouble with slow nutrition, I find the induced current has a very great value in overcoming the congestion and restoring the parts to a normal condition. I only wish to say again that I believe in this particular field there is a great amount of good that can be satisfactorily done by a necessary expenditure of electrical energy.

DR. ROCKWELL: I believe all aurists tell us that ear diseases are proverbially unsatisfactory, and from my own experience I have found it so in regard to electricity in ear diseases. As a rule, I do not get very good results, but occasionally the results are exceedingly good; and while I do not believe one can be sure of uniform results, I would like to speak of a single case which I had some time ago, which is interesting. Now, so far as pain is concerned, I suppose the cause is mostly pressure upon the turbinals, and that is the reason why electricity does so much good in relieving pain. It is a sort of circulatory drainage. It lets up the pressure on the nerve-tissues. Well, about two months ago, Dr. Henry D. Noyes, whom you all know, sent to me a patient who was suffering intense pain in the ear. He did not even condescend to explain to me anything about the case, except to say that she was suffering intense pain in the ear and also in her eyes. She had been suffering this pain for years. I simply introduced in the ear a large piece of absorbent cotton, and then applied the positive pole to that absorbent cotton, placing the other electrode upon the back of the neck. I used the high-tension current in combination with the galvanic current. I used from 2 to 3 milliampères of the galvanic current and of the high-tension current, which, of course, I could not measure, sufficient to produce a very positive, but not painful, effect. I saw the patient six times, and she went away entirely relieved, went to Newport, and just before I came to Washington she returned to my office on her way to Europe, saying that

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she thought frequently of writing to me and telling me what the result had been, and that she suffered no pain from that time until the time she saw me. I can only suppose that there was a congested condition of the middle ear or of the Eustachian tube, and that this application of the two currents set up this circulatory drainage, lessened the pressure upon the nerve-terminals, and in that way relieved the pain. And yet it is surprising, for I cannot understand exactly how the current could accomplish that, being so far from the seat of pain. It only indicates that we do get very excellent results in these conditions at times, without being able positively to explain them.

DR. SCHEPPEGRELL: I would like to ask Dr. Rockwell where he placed the dispersing electrode, and which pole he applied to the ear.

DR. ROCKWELL: I applied the positive pole to the ear and placed the dispersing electrode upon the neck.

DR. MASSEY: Mr. President, I think we can congratulate Dr. Scheppegrell upon producing so illuminating a paper, after having written a large book on the same subject. To write a little when one has written much is oftentimes a feat. And I want to make a plea again for mercury. I don't want to be considered a faddist, but, when we are using the oxidizable metals in cataphoresis, it is extremely easy to use mercury with a copper electrode by simply amalgamating it. Never mind what the size, or shape, or character of the copper pole, it is probably next to the most easily amalgamated metal to be found, and may be heavily coated. The effect is a mixed action, but by far the greater portion of the energy must be expended, I believe, on the mercury, for the staining is very light; it is comparatively a pure mercuric stain; and one can remove all the mercury by using sufficient current, though it takes a much longer time to denude copper than it would to denude gold, showing, of course, that some of the copper is consumed. The fleet-footedness of mercury, its high antiseptic properties, and the old, well-founded belief in its alterative powers would all contribute to recommend its use in such cases.

In Philadelphia, so far as I know, we have no aurist that can be said to be an expert in electro-therapeutics; so that occasionally I have been called upon to do some work of that sort, and I would like to ask Dr. Scheppegrell what kind of an electrode and how he would make contact in an application to the ear for nervous conditions—not for inflammatory deposits. The old-fashioned way was to fill the ear with a saline solution and place the electrode within this, the electrode being insulated with a hard-rubber cone. I have used this method, but have felt that, where we want simply the diffusion of current, —merely its interpolar action,—it might be just as well to use a partially-insulated small bulb, covered with cotton and well moistened, simply inserted into the beginning of the canal. I ask whether, in his opinion, it is better to carry the electrode down close to the normal drum, in such cases.

DR. SCHEPPEGRELL: In answer to Dr. Gibson, I find the positive more effective, and, in atrophied cases, the negative. This, of course, applies simply to the application of the galvanic current. In cataphoric applications another principle holds good. As to the application of the galvanic current to the Eustachian tube by means of a catheter, I would deprecate its use, on account of the local action. This would not apply to the faradic current, in which the

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effects are not so great. But it is often dangerous to apply a catheter itself to the Eustachian tube.

DR. GIBSON: You misunderstand me. I did not mean that the current was applied by a catheter introduced into the Eustachian tube.

DR. SCHEPPEGRELL: Then I think the method loses its value. If a merely external electrode is applied to the nose, and the other to the ear, very little ever gets through the Eustachian tube. In answer to Dr. Massey in reference to the use of mercury in hypertrophies, I consider it a surgical procedure. These surgical applications have been used very extensively in the nose and throat. I myself introduced a method of cataphoresis in hypertrophy of the tongue, five or six years ago, and still use it. The object is the reduction of the hypertrophy, and, while I am not quite certain that the cupric effect has any value, you must distinguish between a disease like cancer, which is distinctly of microbic origin, and hypertrophy, which is simply an overgrowth of the tissue in which we have no microbicidal indication. In the former case the cupric electrolysis is distinctly indicated in the treatment. Now, in answer to Dr. Rockwell, I have found it quite useful to use electricity, either galvanic or faradic, in acute conditions, and I presume that the pain was of acute origin.

DR. ROCKWELL: Dr. Noyes had found no acute inflammation, and that is the reason why he sent her.

DR. SCHEPPEGRELL: Probably a neurotic case, then.

DR. ROCKWELL: The pain must have been due to something of the kind.

DR. SCHEPPEGRELL: I agree with Dr. Rockwell as to the value of the positive pole, but not in the way he applied the positive pole, just by cotton on the outside of the head of the canal. Two milliampères, while it seems to be small in other parts of the body, is a very heavy current if the auditory nerve gets any portion of it, and in its application we ought to apply the dispersing electrode as near as possible to the ear. We find out by experiment that the farther off we place the dispersing electrode the more current will reach the nerve, and in cases in which you have atrophy of the nerve, or want to stimulate the nerve, it is distinctly indicated to place the electrode as far off as possible, and, inversely, to apply it as near as possible when you want to eliminate the nerve.

Replying to Dr. Massey, I simply mention the cupric cataphoresis as a type, because you are more familiar with it. I agree with him that the mercurial cataphoresis has its distinct indication, particularly where there is malignant disease, in which, of course, Dr. Massey has also done a great deal of work, my own being more especially limited to the throat and nose. The stain, in the case of the copper, in the nose and throat is no objection to its value. I will conclude by simply describing a case somewhat out of the line of those mentioned in the paper. The patient was a singer of a great deal of celebrity, who had a disagreeable feature in his voice, that he or any other cultivated ear could notice, although the audience generally would not. It was a little tingling in one of the upper notes. He had been examined by a number of persons, and under the ordinary laryngoscopical examination nothing could be observed. I brought the patient to my house, as I have myself given a good

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deal of attention to music, especially singing, and on testing his voice I found that the abnormal note was due to irregularity of action of the vocal cords—hypæmatosis of one of the vocal cords. That is to say, in order to get a pure musical tone, both vocal cords must beat in unison, and, if one is a little off, then we get an effect that is not a discord, but it shows itself in the voice as a beat. We sometimes notice it in an organ; if you strike a chord of two notes that are near together, every now and then you get a beat that is due to the position of the waves of the sound. Now here we have a case in which you will see the vocal cords were unequally developed. He had noticed that the more he practiced the worse it would become. Naturally, the stronger vocal cord would absorb more of the energy from the exercise, and it became worse. I found it was the left vocal cord which was defective. I then applied the electrical treatment by galvanism directly to the vocal cord so affected, and insisted that he should not use the other—thereby obtaining two effects: exercising in a passive manner, but still exercising, the defective vocal cord, and resting the stronger one. After ten days' application he noticed improvement, so much so that he was encouraged to persevere, and two months afterward the defect had disappeared entirely, and he now has an engagement with a prominent opera company of this country.

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RHEUMATOID ARTHRITIS, AND TREATMENT BY ELECTROSTATIC SPARKS AND THE MORTON WAVE-CURRENT.

By W. B. Snow, M.D., New York City.

The time allotted to this paper permits but brief consideration of rheumatoid arthritis as to etiology, pathology, diagnosis, and course, as the chief object under consideration will be an unpublished method of treatment which we believe offers more relief to the unfortunates who suffer from the affection than any method that has preceded it in the history of the disease.

The generally-accepted condition known as rheumatoid arthritis, or arthritis deformans, is characterized by the following conditions:—

Primarily the disease is one of malnutrition, either local or general, affecting joints bilaterally and usually in groups. It is especially apt to affect the joints of the extremities. The progress is insidious. Few joints are affected at first, later many. The joint first becomes swollen, stiff, and painful on motion. These conditions are gradually intensified. Hardening results, accompanied by lateral deformity, contracture forward, or, in marked cases, backward compensatory curvatures are found in the fingers where several joints are affected.

As the disease progresses the muscles in the vicinity of the affected joints atrophy, probably from disuse, but possibly from trophic changes in the nervous system.

Besides these typical conditions, in some cases there is marked sweating, local or general; in others, subcutaneous nodules, possible erosions, minor sensory symptoms,—as numbness, tingling, and pain, due to a local neuritis,—dislocation of joints, glandular enlargement, especially axillary, when affecting young children. There may also be marked febrile disturbance, and, in rare cases, heart-lesions.

Various views are held regarding the origin. Bannatyne asserts, after a logical discussion and claims to actual discovery, that the germ-theory of causation is practically established. This view, however, Spender and Garrod, in later contributions to the subject, fail to recognize. Charcot's theory, that it is a form of rheumatism and not a distinct affection, or Spender's, that it develops from chronic

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rheumatism, seems at present to be generally disproved, while the generally-accepted view that it has a primary nervous origin seems the most tenable theory. In this latter view, however, there is not sufficient explanation for the pathological conditions which exist in the joints themselves.

Pathologically considered, we less often find, by examination with the x-ray, changes in the bone-structure than is generally inferred. In fact, we are lead to believe that—where such changes as erosions, bony ankylosis, etc., take place—other processes than those characteristic of rheumatoid arthritis are present. This latter condition may more properly be termed osteoarthritis.

Predisposition.

No age or sex is exempt from rheumatoid arthritis. But by far it occurs most frequently in women between twenty-five years of age and the menopause and in aged women. It is essentially a disease of the toilers, usually affecting the joints and members most used, as the hands of housewives and seamstresses. The wealthy are generally exempt from the affection. Family history plays no part in predisposition to the disease. A slight injury—as of the knee-joint, illustrated in Case I, where conditions favorable to the onset are present—may be followed by a severe attack.

Prognosis.

Practically all authorities treating this question give little or no encouragement except a possible arrest and at best but slight improvement in the course of the disease. There are many living examples, especially among the young, which demonstrate the inability of medical science to arrest the progress before the unfortunate subject has become a hopeless, helpless cripple. Osler says: "Arthritis deformans is an incurable disease," and the best that can be hoped for is a gradual arrest. Garrod states: "It is necessary to watch the result of the treatment during a period of several months before any sound prognosis can be safely given, and the patient should be warned that nothing startling in the way of amelioration is to be looked for."

Bannatyne, basing his prognosis on the germ-theory, which he advocates, says: "Once a joint is destroyed, as it rapidly is, we can never make it as of old. Cases seen early may be completely cured,

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but, once the destruction of cartilage has occurred, I see no possibility of this occurring." He adds: "On the whole, I would say that the hope to make the joint or joints as good as they originally were is futile—it cannot be done; but we can relieve pain, subdue the destructive elements, and leave only the actual joint-changes to be controlled." Still states: "Treatment is unsatisfactory." Such we believe at the present time is the uniform concensus of opinion, and yet is it not possible that the future has something better in store for these unfortunate sufferers? Our experience leads us at least to hope that the disease may always be arrested. Prior to the destruction of the ligaments and synovial membranes of a joint, which we do not believe usually takes place within the first two years of the usual progress of the disease, they may be restored to the normal flexibility, and the Heberden nodes removed.

Treatment.

The treatment of rheumatoid arthritis, as embraced in the methods of leading writers, is most unsatisfactory. All agree that it is a most intractable disease, and at best offer only general measures for its relief. The drugs employed are the usual antirheumatics, which are, with most unsatisfactory results, systematically given. If Bannatyne and others believing in a specific germ are able to establish their claim, a serum treatment may successfully combat its inroads and stay the course. The judicious attention to diet, hygiene, and environment has done most in the past for these sufferers. Electricity—that *dernier ressort,* that mysterious invisible force, the last resource for all chronics and incurables—has also been used.

Authorities vary widely in their opinions as to the value of electricity. Osler says: "No benefit can be expected from electricity."

Jones noted that "electricity affords more relief to the patients than any other form of treatment." He employs the alternating currents from the induction-coil, or from an alternating dynamo-supply as well as electric baths. He claims for this treatment relief from pain and stiffness in recent cases; but in those of years' standing offers but temporary relief, and adds that he has had no clear instance of the treatment having lead to complete disappearance of the arthritic tendency.

Garrod recommends, when other measures have failed, the employment of electricity as follows: "A copper plate connected with

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the negative pole of a constant-current battery is placed at the foot of the bath and another similar plate connected with the positive pole is placed at its head. The head and shoulders of the patient are supported by a wooden frame, across which webbing is stretched, which prevents the body from coming into contact with the metallic plate. A current from about 40 No. 1 Leclanché cells is passed through the water for ten minutes." This plan, while successful in the hands of Dr. Steavenson, Garrod says has not been very encouraging in cases which he has watched.

According to Bannatyne, "Weak continuous currents (15 to 25 Leclanché cells), used twice a day, may be of service." He also employs the interrupted current, but never uses either during the acute stages. The only deductions from these suggestions are the same as those from drug treatment: Practically of very little use.

The writer's attention was first called to the electro-static treatment of rheumatoid arthritis in the case of a lady who, having suffered for months while under treatment in Paris by baths and massage and by electricity by Apostoli, had been referred to Dr. William J. Morton. This patient was completely cured by electrostatic sparks applied to the joints of the fingers, knees, and ankles. Since then this plan of treatment has been uniformly successful, both in the Electro-Therapeutic Clinic at the Post-graduate Medical College and Hospital as well as in my private practice. We no longer confine ourselves to the use of the sparks, but find in the combination of sparks with the Morton wave-current, as published in the *Electrical Engineer* of March 2, 1899, a more effective method. In administering this current, metal plates of lead or block tin are closely applied to the surface, and the current permitted to pass until the skin becomes thoroughly moist, which ordinarily requires from ten to fifteen minutes. After this, sparks are applied directly to the affected joints. From 5 to 15 short sparks are administered to each affected finger-joint and a larger number of long sparks to the larger joints. As a rule, these patients are also given a tonic spinal treatment. A metal electrode about one inch in width is applied over the vertebral column from the lumbar region to the cervical, the spark-gap discharging between the prime conductors being varied to suit the idiosyncrasies of the patient. Our experience with these cases is most satisfactory. The stiffness of the joints is so relieved by the first treatment and the patient is so encouraged, that nothing will induce her to give it up. After the first few treatments the

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painful conditions are completely relieved, and the patient who formerly recoiled from the friendly hand-shake now uses her hands without pain. The crooked fingers gradually straighten, and Heberden nodes disappear. We find, as a rule, joints not affected for more than three years completely recover both form and use. To attain these results requires time, patience, and application on the part of the operator at each sitting. As success invariably follows the treatment, is it not fair to presume that the tonic and stimulating process set up by the application of high-potential currents induces a resumption of the normal functions, promoting the catabolic processes, thus removing irritating *débris* which has accumulated about the joints?

The following cases illustrate both methods and results of treatment:—

Case I.—Mr. F. S., aged 50, leather manufacturer. April 24, 1899.

Family History.—Good.

Previous History.—Always well.

Present trouble began about December 15th. Had been working very hard; business required him to run up and down the stairs very often. Both knees began to feel heavy.

In getting off from a Broadway car there was a click, as of two joint-surfaces coming suddenly together. Before reaching the sidewalk it was repeated, and occurred six times in walking a block. Did not notice much during the morning hours. Afternoon noticed a slight stiffening, which increased until evening. Active counter-irritation was employed. At midnight a sharp pain set in, in consequence of which he was unable to move the joint. After four days he was relieved, and within a week was about again.

One week later, after giving the joint a slight strain, was seized with severe pain and obliged to give up. Knee became swollen, with marked point of tenderness over the internal condyle. Rest in bed for twelve days removed pain, tenderness, and swelling. He then went to business for four weeks with fixation-splint to right knee. As soon as he resumed work he again began to feel same heavy feeling in the left knee. Case was diagnosed as rheumatism, and patient was ordered to bed on rigid diet, meats excluded, and massage was administered by a professional. After three weeks patient was no better, but insisted upon getting up, after which he went about on crutches. On examination, the joint was found almost rigid at an

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angle of 130° when flexed, having a range of motion of not more than an arc of 6 inches, and perfectly rigid beyond this point. There was slight swelling of the joints, and slight pain on motion. Pain was only acute at time of outset.

Treatment began on April 24th. Electrostatic sparks were applied to the joint and static frictions; massage to the muscles of the legs. Patient felt decidedly relieved after first treatment.

April 25th. Was able to be on his foot much more yesterday, after treatment, and his knee was decidedly less swollen last evening. He was able to use the foot more, and was without pain.

After the second treatment he could straighten the limb nearly to normal and moved about without any pain. On the fourth day of treatment he reported that he had suffered no pain during the preceding day. The knee became slightly swollen, but the swelling entirely disappeared during the following night. He moved about with the support of a cane for the first time in six weeks, and was able to go up- and down- stairs without his crutches. After six treatments the knee was so improved that for the first time in four months he put on his own stockings. He was able at this time to flex his leg sufficiently to discharge his cab and to ride upon a street-car.

May 3d. Came for the first time without his crutch, and left the office without his cane. Could flex his leg at a right angle. Is gaining strength rapidly.

May 15th. Has had no treatment for four days, but has gained steadily until he can now straighten the limb and flex it to an angle of 75°. He suffered slight pain in both knees. Patient also complains of slight affection in shoulder and arm, having a clicking sensation on motion.

May 31st. Patient, having continued treatment three times weekly, has improved until he goes up- and down- stairs naturally. He suffers no pain, but is still unable to flex his limb to quite the normal extent.

July 11th. During June the patient took treatments and continued to improve. He walked without a cane, using one limb as freely as the other. To-day, after business annoyances, he had a relapse. Active treatment, employing the metallic plate electrodes with the sparks, gave relief as usual. After three days' consecutive treatment in this manner the patient was completely relieved, since which he has had no treatment to this day. Was interviewed in

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September, and was found in his normal health, having full use of both limbs.

CASE II.—Mrs. J. D., colored; aged 40; cook. December 16, 1898.

Family History.—Negative.

Previous History.—Good.

Health generally good. Six weeks ago was attacked with pain and stiffness in the right knee. She was unable to get up and down steps without pain. On examination the knee was found to be slightly swollen and tender.

As patient was not familiar with a static machine, and wishing not to intimidate her by giving sparks, she was placed upon the insulated platform and the joint incased in a block-tin electrode. The Morton wave-current was given for twelve minutes, the prime conductors being separated about three inches. This procedure was the first application of this current to a joint thus affected. It marked the commencement of a new era in the treatment of inflammatory joint affections. The result was a revelation. The patient for the first time in six weeks could walk without pain.

December 17th. Since last treatment patient had comfortable use of the limb until 3 P.M. to-day, when pain returned. Repeated former treatment for fifteen minutes.

December 18th. Is better, but has suffered a great deal on account of injudicious use of limb.

December 19th. Has been more comfortable, and is doing her work with less discomfort than at any time during seven weeks.

December 23d. Is gaining very satisfactorily, and hereafter will take treatment every second day.

December 25th. Has done all her Christmas work with comfort. Feels very happy.

December 29th. Since her right knee is so much improved, she begins to notice an old weakness in her left knee which has troubled her for seventeen years. Gave Morton wave-current as in the other knee.

January 5th. Patient now comes every third day. Suffers no pain, but is stiff.

January 8th. Patient feels about well.

Summary.—Patient took occasioned treatments until April 15th, since which time she has had no return of her old trouble.

CASE III.—L. R. S., aged 8 $^1/_2$ years.

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Family History.—Negative.

Up to three and one-half years of age was a healthy, vigorous child. He then had an attack of rheumatics, which lasted for a few days, and in four months had a second attack from which he entirely recovered.

When four years of age he was again attacked, when most of the larger joints were involved. This time he grew steadily worse. He was taken to experts and treatment actively pursued. Nine months were spent in Bellevue Hospital. Hot air, sulphur-baths, and massage have been systematically employed, and the patient has grown steadily worse.

On June 20th patient was presented for examination. His head was rigid in the position represented in the photograph, and painful when moved. His right hip was disarticulated and knees were in close apposition. The joints of the neck, elbows, wrists, hips and ankles, fingers and toes were all stiff and very painful on slight motion. Digestion and appetite good and bowels regular. Pulse, 120. Temperature, 99.8°.

Urinary Analysis.—Specific gravity, 1.030. Alkaline. Distinct ring of albumin. Pus, and amorphous deposit.

Treatment.—Applied Morton wave-current to knees, elbows, and neck, employing block-tin plates. Treatments were given daily. Spark-gap of from two to four inches was used during each sitting, which lasted from ten to twenty minutes.

June 24th (fourth treatment). Knees, hands, elbows, and neck treated to date. Pain and swelling of joints treated has subsided and range of motion of joints is increasing.

June 26th. Joints previously treated now entirely free from pain on motion and swelling has subsided. To-day treated left hip, knee, and ankle for the first time.

June 30th. Treated all affected joints. All those treated previously are free from pain and tenderness, while the right knee, hip, and ankle are painful.

By thus taking them in series we demonstrate that to the treatment is due the relief. To-day he holds his head nearly upright.

July 3d. All joints except fingers and toes are free from pain and swelling.

July 5th. Before treatment the movements of the hip-joints were greatly improved and entirely free from pain. After treatment could separate knees three inches.

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Fig. 1.—Case III at Beginning of Treatment.

Fig. 2.—Case III, showing Later Condition.

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Temperature, 98.8°. Pulse, 116. Albuminuria persists, with granular casts.

July 7th. Improvement marked.

July 17th. Can separate knees three inches without assistance and four inches with assistance without pain. All joints move more freely.

July 18th. Great improvement in neck. Absolutely no pain in body on manipulation.

Up to present time there has been no return of pain or tenderness. There is an increased range of motion in all joints. Improvement, however, has not been as marked as during the earlier weeks of treatment, on account of irregularity of treatment, owing to summer humidity.

This case has been treated entirely by the Morton wave-current, as, from the youth of the patient, it was found impossible to combine it with sparks, which add much to the successful treatment of all cases of rheumatoid arthritis.

CASE IV.—Mrs. I. C., aged 35. May 26, 1899.

Occupation.—Housewife accustomed to hard work.

Family History.—Negative.

Previous health generally good.

Present trouble began about four months ago with pain in all joints of both hands; also the ankle-joints. All joints are stiff and sore; cannot close the hands without severe pain. Hands are considerably swollen, but do not show marked joint-enlargement.

Treatment.—Sparks were applied to all joints of the hands and to the ankles. Patient bore treatment well and was much relieved. Hands felt much lighter, and she could close them without pain after the first treatment.

May 27th. Patient returned with hands much less swollen and greatly relieved.

May 29th. Patient missed treatment yesterday. To-day there is hardly any swelling in the hands, but patient felt considerable pain in them yesterday.

Ankles have been much better since last treatment and the patient feels much encouraged.

May 31st. Ankles have been free from pain since last treatment and hands have not been so well in months.

Patient continued treatment irregularly for six weeks, during which time she suffered very little and was completely relieved. To

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this date she has since received a few treatments irregularly. When there has been a slight return of the trouble in a few instances the patient has returned for a few treatments, otherwise she has remained free from the trouble.

CASE V.—Miss M. D., aged 24.

Occupation.—Teacher.

Family History.—Negative.

Previous History.—Had measles.

Present Illness.—About November 1, 1897, right foot attacked. The sensation, which resembled needle-pains, was so marked that her face became flushed whenever a paroxysm occurred. Next the fourth finger on her right hand became swollen and blue. The disease then became general. At present, her neck, hands and shoulders, knees, ankles, and feet suffer. All swell at times. When foot was swollen, skin was glossy. When second joint of second finger of the left hand is affected it turns pinkish. Whenever a new site suffers, an inflamed spot appears. Pressure reveals a small, movable nodule. Third and fourth fingers of right hand and first and second fingers of left curve convexly at second knuckles, while first and second of left hand and third and fourth of right curve concavely backward. Pain of trouble is characteristic. When it first came in the foot it felt like needles. She has required a support for all affected parts of body when reclining.

Treatment.—Tape applied to right hand. She was immediately relieved. Sparks given resulted in more motion on shoulder. Used plate treatment for knee. Could walk more freely.

Second treatment: Plate was applied to neck; tape on both hands, sparks given on right shoulder, feet, ankles, and knees.

After first treatment of neck patient was relieved; previously the neck was rigid. Treatment caused hands to be "a great deal more limber." Has had no pain up to August 28th. Fourth finger of right hand is free from pain. Can almost straighten her right hand as well as anyone. The hands are very supple. Can close both hands to palms more closely than at any time since November, 1897.

Right knee was treated on August 26th. She was asked to step from platform and walk. She stepped down with right foot, but the left knee pained her so severely that she could scarcely move. So she stepped back to platform and sparks were administered. She then walked off as easily as a child.

August 29th. She arose at 7.30 A.M. and dressed herself alone:

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the first time for seven months. Her fingers are almost straight and she says her feet have not bothered her in the least.

August 30th. After treatment patient could turn her feet in every way and she felt no stiffness. There is no pain in soles of feet.

September 2d. Has had no treatment since August 31st, yet has had but a slight return of pain in right shoulder. Treatment to-day left her perfectly free from pain.

September 16th. Has not received treatment for one week and has been in a severe rain-storm, yet has felt no ill effects.

To-day she can walk as easily as a healthy individual. All affected parts are free from swelling, pain, and any former tendency to impaired movement.

CASE VI.—Miss B. D. K., aged 25.

Occupation.—Journalist.

Family History.—Negative.

Previous History.—Generally good health.

Present trouble commenced about four and one-half years ago. It started in the middle joint of the middle finger of the right hand. For nearly two years no other joint was affected. Other joints of the same hand except the end-joints of the fingers and the joints of the thumb then gradually became diseased. Not until nine months ago was the left hand involved. The middle joint of the middle finger of the left hand was first attacked. The end-joints are not affected. The metacarpo-phalangeal joint of index finger of each hand is affected.

Occasionally shoulders, hips, knees, and right ankle have shown the trouble. Since both hands have been affected patient has noticed a painful condition of muscles of both arms. Most pain has been on the right side.

When painful, the joints become swollen and red. All fingers show compensatory curvature.

Treatment began about August 20, 1899. Has missed seven treatments in about twenty-five days. Had steady treatment for the first week. It consisted of sparks on the fingers at the fourth and fifth sittings.

Spinal treatment was given. She noticed that the treatment "helped her nerves." Can wear gloves now. Hands are more useful, freer from pain; fingers are straighter and Heberden nodes are disappearing rapidly.

CASE VII.—Mrs. M. S., aged 43. Date, August 19th.

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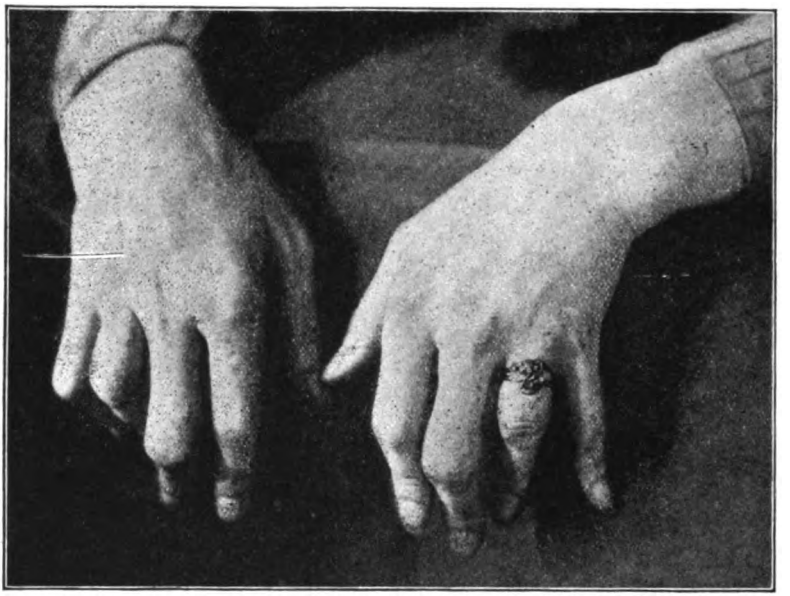

Fig. 3.—Photograph of Hands of Case VII.

Fig. 4.—Radiograph of the Hands in Rheumatoid Arthritis.

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Occupation.—Housewife.

Family History.—Negative. Mother had rheumatoid arthritis.

Previous History.—Ulcerated womb. Anæmic condition. Has used her fingers excessively since she was eleven years old.

Present Illness.—Shooting pains in both hands. Commenced three years ago. No swelling was present. A year ago swelling commenced, and seemed to increase. About a year ago she noticed she could not use her hands as she used to. Right hand was first affected. All end-joints and middle row of finger-joints are affected. For the last few months the fingers have been almost rigid and straight.

Treatment.—August 19th. Sparks on knuckles were given. She said after this treatment that her fingers "got lighter and looser." Before treatment her husband could not grasp the hand. After the first treatment he could. After the third treatment she could wring her clothes with ease. In last joint of second finger left hand, which shows a marked Heberden node, she has had no pain since treatment. Pain and swelling have diminished. Movement has increased.

September 11th. Continued improvement. Nodes are disappearing. Have used plate followed by sparks. Gave sparks to feet. Patient said she could walk with much greater comfort and ease.

September 15th. Can close her hand. Heberden nodes scatter and gradually diminish in size.

September 18th. The largest Heberden node showed marked softness.

Case VIII.—M. W., aged 32. July, 1899.

Occupation.—Seamstress.

Family History.—Father died of rheumatism of the heart. Two brothers have rheumatism.

Previous History.—Colds. Has never lost a day from work, although has never been well.

Present Illness.—A year ago last July her right hand got sore and stiff. "Pain was terrible." Three days later hand began to swell, having been treated with hot water, then cold water. The hand turned cherry color. Within a week, pain, soreness, and swelling had disappeared. Trouble did not return until January. Hands kept getting sore and stiff. The disease then became general. She could not move. All joints were affected, being very painful. This trouble lasted for two weeks. Has been taking medicine ever since. Trouble seems to localize in her hands and feet. All joints of first

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finger on each hand were affected; second row of joints of all fingers on both hands, and terminal row of joints of all fingers on both hands. Lower portion of upper surface of both feet also suffered. Parts were painful. When she came to the clinic she had not closed her hand for three months. The characteristic pain in this case was cramps and radiating needle-pains.

Treatment.—Sparks applied directly to the affected joints of both hands and feet. After the first treatment "hands got soft and the stiffness left them." She could close her hand. On the following day her hands continued to improve. On the third day after treatment the soreness left them; pain and tenderness were all gone and swelling was diminished; after the fourth treatment she was very much improved.

August 18th. After a lapse of a number of days patient returned; pain and soreness have not returned except in foot. Owing to other conditions, patient has not since reported for treatment.

CASE IX.—Mrs. M. G., aged 40. December 1, 1898.

Occupation.—Housewife.

Family History.—Negative. Mother had rheumatism.

Previous History.—Had rheumatoid arthritis in thumbs thirteen years ago. Has been an invalid eighteen years. Had inflammatory rheumatism eleven years ago. Has had muscular rheumatism twice.

Present trouble began two years ago last November. It commenced in right shoulder, then it traveled as follows in order: To the left shoulder, ankles, wrists, and right knee. Pain in foot commenced under instep. It felt as if some one was pressing a lead-pencil against the foot from instep to ankle. Brown pigmentation occurred at the site of the pain. In ankles and wrists pain was gnawing and sharp. In parts of hand pain felt like bruises. She could not even let the water flow over her hands. Fingers could not be used for hours after rising. Thumb was extended outward, and could not be moved. Could not close her hands, or pick anything up, or even throw off the bedclothes. Heberden's nodes, swelling, and pain were present. Right knee was beginning to be immovable. It was very painful and swollen in bunches. Left knee was also painful. Ankles were constantly swollen. For over two years she could not go up- or down- stairs with any comfort. After the first treatment she walked downstairs without pain. Pain was present around shoulder-blade and in lower part of back. The back-pain disappeared after the first treatment. Pain in the back of the neck was

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relieved by three treatments. Pigmentation occurred on patient's hands. It becomes lighter after a treatment. If she takes six treatments it is hardly discernible.

Treatment.—First day's treatment relieved the pain in her feet and ankles. Put on her rubbers and walked downstairs: acts which she had not done for a long time. On account of distance, treatments have been very irregular. Treatment of this case was sparks generally applied to the joints affected, with occasional use of the plate to the fingers and the spinal electrode at each treatment from twenty to thirty minutes. Heberden nodes have disappeared; fingers are straight, strong, useful, and free from pain. Tonic effect of treatment has been very marked, and patient's condition improved in every particular.

CASE X.—Mrs. A. F., aged 50. Neglected case! Date, August 29th.

Occupation.—Housewife.

Family History.—Negative.

Previous History.—Colds. Negative.

Present illness began about eight years ago in little finger of right hand, then pursued the following course: Wrist, elbow, shoulder; metacarpo-phalangeal joints of first, second, and third fingers of right hand; then across to left shoulder, left elbows, and left hand. Onset marked by swelling; terrible pain, more or less constant, like cutting and sawing in the joints of the bone. With a change of weather there is a change of color. Right foot and ankle were affected at the same time as the hand. Cold perspiration noted when pains are severe. On damp days joints are larger, Heberden nodes are very pronounced, and a convex contracture of the fourth finger is present.

SUMMARY.

From the above cases the following conclusions may be drawn:

I. Early in the history of the treatment of each case *pain* is completely relieved.

II. Joints are made not only freely *movable*, but *straightened*.

III. The Heberden nodes are gradually *absorbed* and *disappear*.

IV. After a daily treatment of from seven to ten days a constantly increasing respite may intervene *without return* of symptoms.

V. In *no* case can *extension* of the disease take place if the treatment is continued.

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VI. In cases in childhood, from the experience in Case III, it is fair to presume that the *processes may be stayed* and future suffering and *deformity prevented* by means of the Morton wave-current.

VII. The high-potential currents, by creation of normal metabolic processes, *restore* normal conditions.

DISCUSSION.

DR. WAITE: I have listened with attention to Dr. Snow's description of the cases, and think that they are very interesting, but there are a great many who have used that same method: the new "wave-current" of Dr. Morton that has been in use about one hundred and sixty years—it has been in use ever since static electricity has been used. You will find, also, that static electricity itself is found to be an oscillatory current. The electrodes are fully described by Dr. Watson, in a volume published over a hundred years ago, and though this does not affect the value of the paper as to results, we think that credit as to discoveries should go where it belongs.

DR. ROCKWELL: Mr. Chairman, I must say that I agree with the last speaker in saying that in its essential characteristics there is nothing new about the method that Dr. Snow has spoken of. I am sure that we all have used essentially the same thing for years. And then, again, it seems to me that the author has tried to prove too much in his paper. I am not the only person who has had experience with essentially the same method of treatment, and I should want a good deal more evidence than has been given to-day to show me that such results could be uniformly obtained. Of course, we don't want to say anything against the statements of an individual, but we must not claim so much that it will discourage outsiders in believing that there is something in electro-therapeutics. If you can do for that condition what the author claims, you can overcome what has hitherto seemed to be an incurable condition.

DR. MASSEY: Well, one might say, Mr. President, that the Norsemen discovered America, too: for it is *how* things are done that is an important point. Dr. Rockwell may be correct about the overenthusiasm of this report, yet the personalities of the individuals making it would seem to me to carry some conviction. Personally, I never heard of any of these cases being benefited by anything up to the present point. It is the first news to me of any such cures in rheumatoid arthritis, and I have used the galvanic current for this trouble, but never used the static, at least effectively. That is where Dr. Rockwell's experience may be ahead of me. The use of some method *effectively* is the point. It would seem to me that there are two items in this method which deviate a little from our previous experience. The author says it takes half an hour to make a satisfactory application. We may not all of us use it for half an hour. The other point is that a large number of sparks were probably used, on account of the proximity of the electrode to the skin surface. As I gather it, it is a very definite and continuous application to the local spot. There is an enormous variation in the methods in which static electricity may be used or misused in individual cases; the method is all-important, and one

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man might get by correct technique what another had not gotten by not having as good technique.

DR. GIBSON: It would be very desirable to see the doctor use that Morton wave-current so that we could understand it. I am a great advocate of it myself, and, as the members of the society probably do not understand the method, he would have a good opportunity of showing it to us.

DR. NUNN: The questions that I would refer to have been covered very well by Dr. Massey. I wanted to know what the novelty in this treatment was: what is called the Morton wave-current. I don't believe the term yet exists in our phraseology. Do I understand that the tin electrode was necessary there?

DR. SNOW: No, only a matter of convenience.

DR. NUNN: Because I have seen similar applications made with ordinary electrodes, or wire electrodes, or any other material that may have been placed in position. The members will recollect that a day or two ago I called attention to the absorption, on my own person, of an arthritic joint, through the influence of the static current. There was nothing special about it that I could see.

DR. GIBSON: Mr. President, it would look as if the application that is able to absorb the salts that accumulate around the joints may accomplish the liberation of the confinement of these joints, and might relieve the pain that is due to pressure: but where there has been a fixation for years all the electricity between now and creation won't relieve it.

DR. ROCKWELL: I will say that those photographs are very interesting to look at, but it is such an important condition that we should know rightly about these things that are so interesting. If the reader had given us "before and after" illustrations in photographs of the resolution of these conditions it would have been better.

DR. SNOW: That is an unfortunate omission which I will explain.

DR. WATSON: I have had considerable experience in using the electrodes somewhat after the methods that Dr. Snow mentions, but, I am sorry to say, not with the results that he speaks of. However, in some instances I had very happy results. I only hope that they have struck upon something that is going to get better results than I have been able to get, and I am inclined to believe that it depends upon the length of time that they give this treatment. I am inclined to believe that I have been too short in the time allowed to each case. I know I have not given it fifteen minutes, as a rule. I believe that there is where we have made a mistake. If we use the contact treatment at all, that he mentions, I believe it ought to be done in the manner he speaks of. I would like to see some of these photographs after the cure had been effected,—as the late speaker remarked,—and see some of the changes that come about.

DR. KELLOGG: I will say, briefly, that I am very much interested in this paper, and I think it is well that the paper has been brought forward, to increase our faith in static electricity as a means of relieving these sufferers. I have been using the static spark for some sixteen years, with some very good results. The first case in which I had a tangible result was that of a lady from

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St. Louis, who was so badly deformed that she could not stand erect, could not straighten her limbs, could not place her hands to her head, could not shut her fingers. She was suffering great pain. I ordered the application of sparks in her case, though I did not have very much faith in it. I thought I would try it as a means of relieving pain. It gave here so much relief that I constantly found her lingering round the machine as long as she stayed. She usually stayed thirty or forty minutes, and I took all of that time to give the treatment. This patient made a good recovery. She recovered in about six months. She was able to raise her hands, and comb her hair, and enjoys good health. But I didn't attribute the recovery to the application of the static current. I think the cases the doctor has treated were fortunate, but I should expect relapses unless the patient cured the bad habits of life that had brought about this condition. It seems to show that electrotherapy should be combined with other means, directed to the causal conditions.

DR. CLEAVES: I only wish to say, Mr. President, that I have seen a very marked improvement in a considerable number of cases of rheumatoid arthritis from the franklinic current. The time it is used is an important element. The physiological effect is the same whether we use the Morton wave-current or whether the patient is insulated and the spark is used. It does matter, however, whether we are able to make an application so that it is painless. In this method, as with the Leyden jar, the expenditure of energy produces less pain, and therefore is better tolerated, and more work is done. I think we must be glad of any results by this method rather than by that painful method of the disruptive discharge. But we cannot be too careful to remember that they all produce the same effect, and that they have no essential differences whatever.

DR. SNOW (in conclusion): I appreciate the fact that I threw a boomerang. I knew it when I made these statements. But I stand back of them firmly, and I state now that, though I have not those pictures of the hands, that the statements as contained in the records of the ten cases which I did read are all absolutely correct, and the hands could be shown and the histories corroborated; and the reason that I had not them here is because, until comparatively recently, I had not thought of reading a paper on the subject, and had not taken into sufficient account the value of having those representations, as I have in the case of the boy.

Now to answer, first, Dr. Waite's remarks. I don't care anything about priority of knowledge. If that knowledge has not been published to the profession, it is *nil*. The Morton wave-current has that name to-day, and that name will probably live with it, regardless of the fact that there may be some that detract from it. But to that current the medical profession must look to-day for some of its best results, not only in the treatment of rheumatoid arthritis, but of painful conditions. You will relieve an acute tic douloureux in its commencing stages, as I have with certainty, or any neuralgic affection where there is no neuritic process or irremediable pressure upon the nerve.

Now, as to Dr. Rockwell's remarks, I have this to say: I feel that the doctor, while he says the disease has been treated, the current used, and all this, has not given sufficient attention to the particular disease. I had a fine

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opportunity in the New York Post-graduate Hospital to see a large number of cases—and lately, since we have a reputation for treating these diseases, the practice is gradually multiplying. This has afforded me a chance which some others may not have had. Those practicing, perhaps, among the better classes do not find these cases, but in the clinic we find them abundantly, and our results are uniform.

In referring to Dr. Kellogg's remarks, I want to say specifically that none of these cases have ever received any other treatment. You will observe I stated that along with local treatment I used a spinal tonic treatment. I dare say none of you have had any experience with this treatment, and consequently of its merits you know little. It consists in this: a metal electrode, be it tin, lead, copper, or some other flexible material, is passed down over the vertebral column, and kept in close contact with the surface, the electrode being not more than one inch in width and eighteen to twenty-one inches long, so that you will not have too large a surface over which the discharge is received from the machine. In that case the consequence is that you cannot get sufficient electromotive force to carry the current deep enough into the tissues, and you find that relative to the physical size of the patient must be the nature of the spark-gap running during the treatment. This I call the tonic treatment. This is the treatment which sets up the healthy metabolic processes, not only in the local, but the general system, by setting up the normal activities, as you do by the spark-discharge, which is very painful and disagreeable. Now, I have not found a cure-all, neither am I so enthusiastic in my paper that I wish to bring a stigma of humbuggery on the medical profession, because no one to-day regrets more emphatically than I do that the medical profession, as a rule, look upon electrostatic and electrical treatment in general as a form of humbug practice, because so many quacks use it as a means of imposing on the public. But that there is real good in the subject we come to understand from the results obtained, and the experiences received by the various members of this association, as represented in their able papers. I wish to say this: that the Morton wave-current, as applied to the surface before the sparks are given, has a tendency to soften the tissues, and I have found that we get a better effect by following this with the sparks. In the case of the little boy there was never a spark applied. I believe, from my experience with this one case, that we have a method of value in cases of similar sort, in which, though all the joints are not involved, the painful joints may be controlled, the painful processes stopped, and the patients put in a way to a useful existence. For, in time, as in all acute cases, the neuritis of the disease will cease. I know of an instance of a young man, 21 years old, that, up to thirteen years, suffered with rigid joints, his head drawn down; but is now well and hearty in every particular. The course of our treatments, extending only through two years, is not long enough to establish certain points conclusively, but we have every reason to believe that we have found a means, not only of mitigating, but of curing, the disease. Two years in the treatment of rheumatoid arthritis is too short a time to determine whether those cases are going to be cured. In the treatment of these cases, bear in mind that time is the element in each treatment. Your patient recoils from the spark which is so painful, but by getting her confidence, and by proceeding patiently with

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the wave-current, you will go on and administer sufficient in every case, and after once or twice, in the most timid case, they will want you to give them all you think is best. They are only too satisfied to have found relief, after having been told by the profession that their disease was incurable.

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THE TREATMENT OF CANCER BY THE MASSEY METHOD OF CATAPHORIC DIFFUSION OF THE OXYCHLORIDES OF MERCURY AND ZINC.

By G. Betton Massey, M.D., Philadelphia.

The electrolytic decomposition of mercury in contact with the gold anode of a galvanic current inserted into a malignant tumor, and the diffusion of the mercuric compounds thus formed through the diseased area by the cataphoric action of the current, is a contribution to practical surgery for which the writer claims the credit of discovery and invention. It is evident that in this process we have a means of sterilizing any focus of germ-growth or morbid cell-life in any portion of the body that can be safely reached by the current, the principal essential conditions to its use being the situation of the growth at a sufficient distance from the vital centres and the necessity for a drainage-path for the escape of a portion, at least, of the devitalized structure.

The process gives us a scientific method for the destruction, under anæsthesia, of the essential disease elements in early local cancerous growths in accessible situations, of all tuberculous deposits in the body except within the skull, thoracic and abdominal cavities, and of such acute local infections as carbuncle, poisoned wounds, etc.

The pathological fact underlying its use in cancerous growths is that the various malignant affections grouped under the general name of cancer are due to the presence of an abnormal cell-life at the site of the disease, partaking of the nature of a foreign invasion of the body structures, which, in its inception and early stages, is strictly limited in situation to the infected locality. In the present state of our knowledge it is impossible to decide whether these foci of abnormal cell-life are made up of living integers of extraneous or parasitic origin, as many now believe, or merely of errant intrinsic cell-units that have, in some way, changed their character and become cells of prey, as it were. Whichever of these hypotheses is true, the fact remains that the interstitial diffusion of a protoplasmic poison in a nascent condition—into, through, and around these cells —is a most effectual way of destroying the essential elements of the cancer-life, since in either case this life is a manifestation of local protoplasmic bodies.

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In its application to cancer the process must be of such a thorough nature that not one of the morbid cells or germs may escape infiltration with the germicide. The massive dose required to secure this end results in the formation of two distinct zones of action, that nearest the active electrode being an area in which all vital cells are necrosed, the aseptic slough thus formed being limited by a subsequently-developed line of demarkation, and separating in from two to six weeks after the application. Beyond this line of demarkation, which limits the area in which the stroma of the affected organ is devitalized along with the morbid cells, the radiating stream of mercuric oxychloride will be diffused to a considerable distance, depending in extent on the amount and duration of the current, and will produce a zone of sterilization in which the cancer-cells will succumb, while the normal tissue-cells are only irritated.

It is this zone of sterilization particularly which constitutes the chief value of the cataphoric treatment of cancer, for by it we may reach those outlying colonies of morbid germs that constitute the so-called roots of cancer, and which, in their latent condition, are apt to be missed by other methods of destruction or removal, where only what is seen can be removed. The failure to destroy these colonies is the reason for the recurrence of the growth after the use of the knife or caustics.

It is best to make an effort to destroy all germs at once when we are dealing with the more malignant varieties of carcinoma and sarcoma, since a mere wound of these colonies results in the attraction of added blood-supply and more luxurious growth. To do this in a single application requires a current of from 200 to 1200 milliampères, and necessitates placing the patient under a general anæsthetic. The duration of such an application has varied in my cases from fifteen minutes to an hour and a half, the latter only in extensive growths situated near vital organs, as about the head and neck, where the effect of large currents on the respiration and circulation restricted the strength to 300 or 400 milliampères only.

The current-supply is derived from two or three sulpho-chromic-acid batteries connected in series, making a total of sixty or eighty cells, with a voltage of 120 or 160 volts, held in control by an efficient controller. This latter instrument I have been compelled to have made to order by the McIntosh Company, and when the larger currents are used I have also employed a specially-constructed Weston meter reading to the desired amounts.

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The portable acid batteries now generally in use are so flimsy and possess such small cells as to necessitate the construction of batteries with larger elements and cells for this work, which have been made for me by Williams, Brown & Earle, of Philadelphia, under the name of the "Massey Transportable Battery," in which the cells are of glass, and more convenient arrangements for raising and lowering the elements by a worm-screw and bevel-gear have been adopted.

The active electrode is a cannula made of 18-karat gold, lined with platinum for greater durability when the pure mercuric cataphoresis is to be employed. The portion of the electrode to be inserted into the growth is freely amalgamated with mercury, and after its insertion an excess of metallic mercury is injected through the tubular centre of the instrument by means of a glass syringe attached to it by a piece of rubber tubing. This excess of mercury is intended to surround the active end of the electrode within the growth to insure a full supply of mercury during the action of a powerful current, as otherwise the gold point will become bare of this material in a few minutes. The shank of the instrument is insulated with shellac or fused hard rubber when the application is made within a natural cavity.

In cases where much tissue is to be destroyed, or where it is difficult to inject the mercury, I have used solid pointed electrodes of zinc freely amalgamated with mercury, which results in the formation and radiation of the mixed oxychlorides of mercury and zinc, and the enlargement of the area of necrosis under the same current and duration.

The indifferent, negative electrode is made of a large plate of lead, to which a suitable binding-post is attached, and over which is laid a thick pad made of eight or nine layers of thick cotton absorbent material well soaked in water. This plate and pad are fully as large as the entire back of the patient's trunk, and on it the patient reclines during the operation, the operating-couch being preferably a spring cot covered with rubber cloth rather than a table, in order that this pad may remain in uniform contact with the skin during the movements naturally made by a person under the influence of ether.

The patient is placed on this pad and couch after all the apparatus has been arranged and tested. When thoroughly under ether the active electrode is inserted into the centre of the growth, the

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mercury injected, and the current turned on in a gradual manner, avoiding shock or sudden increase. The production of the area of necrosis may be seen to begin at once with an effective current: a drab-colored softening spreading in all directions from the instrument. At the end of a varying number of minutes the whole tumor becomes softened as this area increases, the brawny hardness of the malignant tissue changing to a doughy softness, as though a cellular erectility had disappeared coincident with the loss of vitality in the malignant cells. The process should be kept up until the area of necrosis is coterminous with the apparent limits of the growth, the zone of sterilization being depended upon to kill the outlying cells only.

The eschar thus formed is painless and inodorous, and separates in due time, the cavity left being allowed to fill with healthy granulations.

Aside from the limitations to the use of this method mentioned at the beginning of this article, it should be stated that its effectiveness in accomplishing a permanent cure is in a direct relation to the earliness of the stage of the disease. A cure cannot be promised in an inoperable case, though its value as a palliative in this stage is very great, and some inoperable cases, as well as others very difficult to reach with the knife, have been cured. Primary growths and early local recurrences are best adapted to secure the best ultimate results, though several of my cases have been followed into the first gland of the axillary chain in breast cases, when this gland alone was infected. In these cases this gland was destroyed separately at the same operation, and the result in two instances has been the destruction of the infection in this situation also.

A notable value of the method in certain cases is the possibility of destroying the cancerous growth in an organ without destruction or removal of the unaffected portion.

It is also a convenient form of operation for cavities, such as the mouth, rectum, etc., as the instruments may be insulated to the point of attack. Finally, as the method is absolutely bloodless after the first prick in inserting the electrode, by reason of the positive pole being used, it commends itself in the eradication of highly-vascular sarcomas.

In a paper recently read before the American Medical Association a number of successful cases were reported in detail and the following summary of the total number of cases given. This sum-

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mary includes the initial experimental work; of course, some of the inoperable cases having been mere forlorn hopes:—

In 10 operable cases of carcinoma and sarcoma, including several recurrences after operation with the knife, the results were as follows:—

Cured	8
Probably cured	1
Failed to cure	1
Total	10

In 16 inoperable cases, most of them mere forlorn hopes, the results were as follows:—

Cured	2
Probably cured	1
Failed to cure	13
Total	16

DISCUSSION.

DR. CLEAVES: I would like to ask Dr. Massey if he has ever used a smaller dose in the malignant troubles. I ask this question because I doubt how much is due to the action of the electricity and how much to the mercury.

DR. NUNN: This paper is of exceeding interest to me, as it awakens some reminiscences in reference to the efforts to treat cancerous growths. When I was an apprentice, some fifty years ago, my master instilled into me one principle in regard to all these forms of cancer. He said: "We are unsuccessful in the treatment of cancer, but the day is coming when there will be some application found which will have a selective power upon this cancerous growth, and will follow it, as it were, into its recesses, and then you will have a successful treatment." And he said: "Remember this." I can recall that the method that he employed then, and which was, to a certain extent, successful, was the application of arsenite of mercury, which was made by Donovan, whose reputation we all know. Donovan made for him a concentrated Donovan solution, that I have never been able to have made since. I had some of it. It descended to me, and I used it all up, I am sorry to say, and I have never been able to get any more, nor have I been able to make a solution having a similar appearance or effect. I don't know how Donovan made it. He was a very peculiar person. I knew him as a boy. I have followed that up, and with the arsenite of mercury and polar action I have been very successful—not equally with Dr. Massey. I wish to draw attention to this fact: that there is an apparent selective action of these medicines, even where they are applied medicinally, or with electricity,

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which latter method is, of course, far superior to any other method, and that between these two there is a grand field for the treatment of cancer, subject to that principle. Whether this will be the method that will prevail is another question, but the point is to find a medicine which will have a selective action for the cancerous growth, over and above that which it has for the healthy tissue.

DR. ROCKWELL: I hope, with Dr. Nunn, that the time will come when we will be able to do something with cancer. Those of you who go back to the ancient time will perhaps remember the rather persistent efforts made by Dr. Beard and myself in the treatment of cancer. We saw pain relieved, and we saw, sometimes, a diminution of size—sometimes a considerable diminution in size, but a reduction only because of the destruction of tissue and the loss of substance in that way. I think we demonstrated pretty clearly one thing: that electricity alone had but little power in the cure of cancer. But I am glad that Dr. Massey has gone into this thing, and the only hope I have that this method of cataphoresis will be of service in cancer is that there is strong hope for believing that at its inception cancer is of local origin. You remember Dr. Morgan's thesis, some years ago, and his argument was strong in showing that at its first inception cancer may be of local origin, and if you take these conditions soon enough—if Dr. Massey takes them in their early stages, I hope that he will get a radical result. I hope he will do so if he takes them late, but I doubt it.

DR. SCHEPPEGRELL: I have followed for a long time past Dr. Massey's work in this direction. I think he is in an excellent field, doing good work. At the same time we must think of the possibility of enlarging this field. He mentioned, for instance, outside of the effect locally, an effect immediately around the growth, owing to the fact of the infiltration. If that is the case, why not combine it with the surgical method, and after having gotten rid of the diseased area, as far as surgery will permit, then apply this mercuric method to follow it into the affected glands, and by combining the methods effect a much more favorable result than from any one individually?

Some time ago I had a case of epithelioma at the base of the tongue. It was absolutely unbearable. The patient was too old and the growth too far back for the tongue to be removed. I made use of cataphoresis in this case, using the zinc method. In another case I believe I would use the mercuric. But I did use the zinc in that case, and I was very much surprised at the manner in which it acted. The growth was probably three-quarters of an inch in diameter, and it gradually became less, until after the end of six weeks it was barely above the surface. Unfortunately a metastasis took place, and developed another growth in the stomach, which so weakened the patient that he afterward died from the general condition. But I was very much pleased at the effect of the treatment upon the primary growth.

DR. KELLOGG: I have been for a good many years interested in the treatment of cancer. Over thirty-five years ago, when I was assisting Dr. George M. Beard at the dispensary, I found him using electricity in the manner referred to by Dr. Rockwell, in what he called "working at the base." His method was, after the cancer was removed, to apply the electrodes around the circumference,

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especially in the directions in which it might be shown that recurrences extended: and Dr. Beard claimed—I did not see very many cases—but he claimed to have obtained very good results from this method. Some years later, about sixteen years ago, I spent some little time in the Cancer Hospital in London, studying their methods. There they applied arsenic upon the base, and made various other applications. I made a study of the different methods of treating cancer, and my conclusion was that every agent has some selective power. Healthy cells will resist destructive agents more than morbid cells; hence every agent, whether poison, toxic substances, or heat or cold, and everything which has a destructive power, has a certain amount of selective influence, because it will destroy more quickly those cells which are morbid than healthy cells, which have a high resistance. So it seems to me not probable that we shall find any particular agent or application of any kind which has a specifically-selective influence over the cancer growth, or over cancer-germs, or the cancer-plasm, or whatever it may be. Now it seems to me, sir, that the great difficulty we have to contend with in the treatment of cancer is not altogether the fact that we cannot remove all of the outside structure of the cancer, or the morbid growth, but that we cannot judge the patient. A well man never gets sick of anything. A man that is thoroughly well does not get sick. A man is already sick when he gets sick. He was sick before, or he would not have gotten sick. That seems paradoxical, perhaps. But some of you will remember that notable instance in which a pint of beef-tea in which cholera bacilli had been cultivated for several days, was drunk to prove that the cholera bacillus was harmless. For some time there was serious doubt whether Professor Koch had discovered the cholera microbe. Down at Chicago we live largely on germs. The germ is just as harmless as any other kind of matter, provided the stomach is able to digest it. People get sick with cancer because they have a weak constitution which is susceptible to cancer. It is only a sick man that gets tuberculosis. He must be reduced to a low level of vitality before he can become infected. A healthy man's organism is able to destroy every organism that can get into it. But it is simply the parasite that fastens itself upon the man who is already decaying, that makes the man sick with cancer. This question is a very important one. It was pointed out by a New York surgeon some time ago that, if cancer continues to increase at the present rate, it will become a leading disease in New York within ten years of the present time. If that is true, it is a very remarkable fact. It is true that cancer is increasing in all civilized lands, and to a very remarkable degree in some countries. In England cancer has increased forty times in the last century. It is found in England that it is increasing in colonies. It is simply enlarging in certain districts, showing that there is a large infection. Now the reason that cancer returned in the case spoken of by a previous speaker was because that patient had a susceptible system, exposed to the same conditions that it had before. Experiments have been made in Paris and Berlin, probably familiar to everyone here, showing that you cannot inoculate a healthy man with cancer, but a man who already has cancer can be inoculated with it. Any number of cancerous growths can be produced upon a man who has cancer, but a healthy man cannot be inoculated with cancer. The fact that a man has cancer shows that he has acquired a constitution that makes him sus-

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ceptible to the disease. Now, we cannot change that constitution; consequently we cannot probably ever find anything that will be a panacea for cancer. If the doctor's paper has given us important facts with regard to a new method, it will be well worth utilizing. It seems to me that the most practical method in the majority of cases is the knife. If you have cancer of the mammary gland, for instance, it is not at all safe to risk leaving a portion of the gland. My practice is to remove all the glandular tissue and the fat of the axillary region. I have found, deep down in the fat around the axillary region, little, tiny, infected glands as large as a grain of wheat or rice, and it would be impossible to reach these by any application to the gland itself. It is hardly possible to suppose that the selective influence would prevail fully in this way. I have sometimes examined the axilla for infected glands, and could not find the least trace, but upon taking out the fat and picking it over, small infected glands would be found. So it seems to me that the knife is the safest remedy. I dare say we are all exposed more or less to cancer. The reason why we do not all have cancer is because we are on a plane above cancer. We have not come down to the cancer-level. When the person has the disease, he has gotten down to the cancer-area, so that, when exposed to these cancerous elements, he is likely to get it. The disease is increasing with great rapidity, and anything that offers the least chance for its diminution is a great addition to our knowledge.

DR. BISHOP: The way to find out how to do the thing is to find out what you want to do. I have been interested in what Dr. Kellogg said about the increase of cancer. In the last quarter of this century the medical books have paid a great deal of attention to cancer, and some undertook to establish the identity of cancer and syphilis. Nearly all, if not all, the local treatment was confined to the use of perhaps three methods: mercury, zinc, and arsenic. They were the three principal methods, and nearly all were based on one or the other of the combinations.

It has been said that it was from a mechanical effect that mercury exerted a remedial influence as an irritant to the molecules, and that that started up a healthy condition. Now, if that is true it explains the advantage of this electrical deposition of mercury for cancer. Why would not it be well to administer large doses of arsenic and mercury to get the constitutional effect as well as the local effect? But, after all, Dr. Kellogg's idea is the best: whenever you can cut anything off, cut it off.

DR. REYBURN: I have heard the paper with a great deal of interest. One thing I would like to inquire. In a case of carcinoma of the breast would he make an incision and apply the electrode in the centre of the growth, or around its periphery? Dr. Kellogg might have said that the operation he speaks of—the radical operation with the knife, in which the whole breast is removed, uncovering the pectoral muscles, and taking out all of the axillary glands—has raised the success of cancer operations very materially—from 8 per cent. to 25 per cent. of cures. But we ought to remember that some patients will not submit to the knife, and, in cases of that kind, and where the system is not likely to become affected, I think the operation of Dr. Massey will be a very good one, indeed. I want to use it, and I would like to get this little hint in regard to the operation in the case of the breast.

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DR. MASSEY: I will try to answer the questions *seriatim*. And first, in regard to Dr. Cleaves's question, as to whether this was simply an application of electrolysis, or the physical effect of the cataphoric action of the chemicals. And I might add to that Dr. Bishop's idea, as a part of the same branch of the subject. I claim that the destruction of the cancer-germs is due chiefly to the diffusion of the chemicals, and I will recite a case that will prove this. But it is also due in part to the idea that I thought Dr. Bishop was enunciating: to an aroused physiological activity of the tissues, where the germs are weakened and the tissues and the cells are strengthened. It is even possible that it is not necessary to kill all the germs, if we arouse sufficient activity in the surrounding cells to squeeze out the life from the few remaining cancer-cells; in other words, to produce a reaction in that zone. Now, this case proves that there is a zone of sterilization and reaction, extending beyond the area of destruction, which is the most important part of this method, the other part being a mere substitute for the knife, doing the same in a clean chemical way, but still leaving a big hole, which the knife would not leave. This important fact that there is a death-dealing effect upon germs in the tissues, where the tissues themselves are not destroyed, was proved by this case.

The case was that of a physician of York, Pa., who came under treatment for a rodent epithelioma of the face of twenty years' duration, that had recurred after removal by the knife. The ulceration involved the whole upper part of the face on the right side, denuding the skull and laying the orbit open. It was cured by the slow method of cataphoresis of mixed mercury and zinc oxychlorides, the applications being made by small slivers of amalgamated zinc, which were thrust into the middle of the diseased area, and but 2 to 8 milliampères employed under cocaine. As a result of repeated applications of this nature, the surrounding healthy skin granulated inward, and a mere linear scar was the result. There was every evidence that the flesh became thoroughly impregnated with the oxychloride for several inches in all directions. The applications were made daily for three months, with intervals of enforced rest, due to the reaction.

Concerning Dr. Kellogg's remarks, I am very glad that the doctor presented the other side,—*i.e.*, presented the claims of the regnant method of treating cancer,—because I think that the regnant method will probably, for years at least, remain the best method in many cases. But I believe that the present ideas of it are not entirely correct. For instance, if, as the doctor says, the cancer patient is always inoculable—more so than another patient will be—then there is a possibility of inoculating the wound made by the knife in the removal of a cancer—an autoinoculation of the germs, which could not be if we killed all the germs. The other point is this: Though the total removal of the breast is certainly often an advantage, and has brought up the statistics, as Dr. Reyburn says, to a far greater number of cures than was formerly possible, through the carrying of the operation into the axilla and taking everything out; this may be said against it, and should be taken into consideration before doing this extensive operation: we won't mention the woman losing all of the breast, though, patients think of that, but if all those glands, both healthy and unhealthy, are taken out at once, there is a serious risk. What buffer has that patient from the internal growth, if there is a recurrence at the site of the opera-

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tion? That is the point that I made against the knife method, in talking with Dr. Keen, some time ago. By the wholesale removal of glands the patient is deprived, not only of the natural buffer against recurrence, but of a buffer against constitutional infection in case there is local recurrence. This is a point for decision, whether one should remove all, or take the risk of there being some glands infected without its being known at this time. In my method I can treat each of those glands as soon as they appear to be diseased.

The only other point I want to mention is in answer to Dr. Reyburn. In small breast cases I make one incision, with one electrode in the centre, and trust to the immense power that is used to carry the mercury to the point that we wish—to the practical periphery of the growth. But in other cases it is wise to make a number of incisions, putting one electrode here, and another there, in different portions of the periphery, causing the effects to meet. But one must be careful not to minimize the action by having too many electrodes at work at once. In this major application we should have at least 200 milliampères to each active electrode.

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THE MODALITIES OF INDUCED CURRENTS USED IN THERAPEUTICS.

By William J. Herdman, M.D., LL.D.,
University of Michigan, Ann Arbor, Michigan.

The modalities which I purpose to consider at this time are those furnished by:—

The physician's induction-coil.
The magneto-electric machine.
The sinusoidal apparatus.
The alternating dynamo.

The modality of an electric current corresponds to what d'Arsonval has designated the "characteristic of excitation," and it is upon this that the physiological, as well as the therapeutic, effect of each form of electricity made use of by the physician depends. It is important, then, that the operator in electrotherapy be well instructed in the physical characteristics of the electric currents he employs.

Nature of Induction-coil Currents.—The nature and modalities of the several electric currents that are derived from the induction-coil need to be considered separately. When this apparatus is in action it is capable of generating three distinct currents:

The battery current.
The primary induced current.
The secondary induced current.

The Battery Current.—No attempt is made to use for therapeutic purposes the battery current in the induction-coil apparatus. Its function is to supply an electromotive force in such manner as to create magnetic lines of force in the temporary magnet and exercise an inductive influence upon the coils. In order to effect this so as to secure a succession of induction-current impulses, the battery current must be interrupted with more or less frequency, as it is only by varying the number of lines of force that cut across the coils that an induced current is created in them. The "make" and "break" of the battery current, which is effected by the interrupter, is an indispensable feature, therefore, in the induction-coil apparatus. And the frequency with which these interruptions in the

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battery current take place determines, in a great measure, the nature and physiological and therapeutic effect of the induced currents which follow. The battery current should be strong enough to saturate the temporary magnet with a magnetic flux and to successfully withstand the opposing electromotive force which is created by self-induction in the primary and secondary coils when their circuits are closed. The larger the temporary magnet and the greater the resistance and number of turns in the primary and secondary coils, the greater will need to be the electromotive force of the primary battery used for furnishing this battery current. The battery current (*A B B B A'* in Fig. 1) is, of course, a direct or galvanic current,—that is, a unidirectional current,—but it is interrupted or broken as often as the spring (*H*) is carried away from the contact (*M*). The electromotive force of this current depends upon the kind and number of cells used, and the amount of current depends upon the resistance of the circuit. The quantity of current may vary, therefore, from half an ampère to several ampères, according to the make-up of the apparatus.

Modality of the Primary Induced Current.—At the moment the magnetic lines of force which emanate from the temporary magnet as a result of the influence of the battery current begin to cut the turns of the primary coil, an electromotive force is generated by them in the primary coil, which is opposed to the flow of the battery current and decreases it. When the battery current is interrupted by the breaking of the circuit at the spring vibrator, the inductive influence of this current on the temporary magnet ceases, and there is a sudden withdrawal of the magnetic lines of force which came from this source. This sudden loss of potential creates an induced current in the primary coil which has the same direction as the battery current; but, as the battery circuit is open between the contact-point and the spring, this current can only traverse that circuit by leaping the air-gap. This it does at times, and causes the spark which is seen at this point when the instrument is in action. If another circuit including the patient is provided (*C*, *C'*, Fig. 1) for the current that is thus induced in the primary coil at the "break" of the battery current, this induced current at the "break" can be utilized in therapeutic work. This is the origin of the current derived from the medical induction-coil that goes by the name of the *primary current*. It is a unidirectional current, but one that is interrupted with a frequency corresponding to the movements of the vi-

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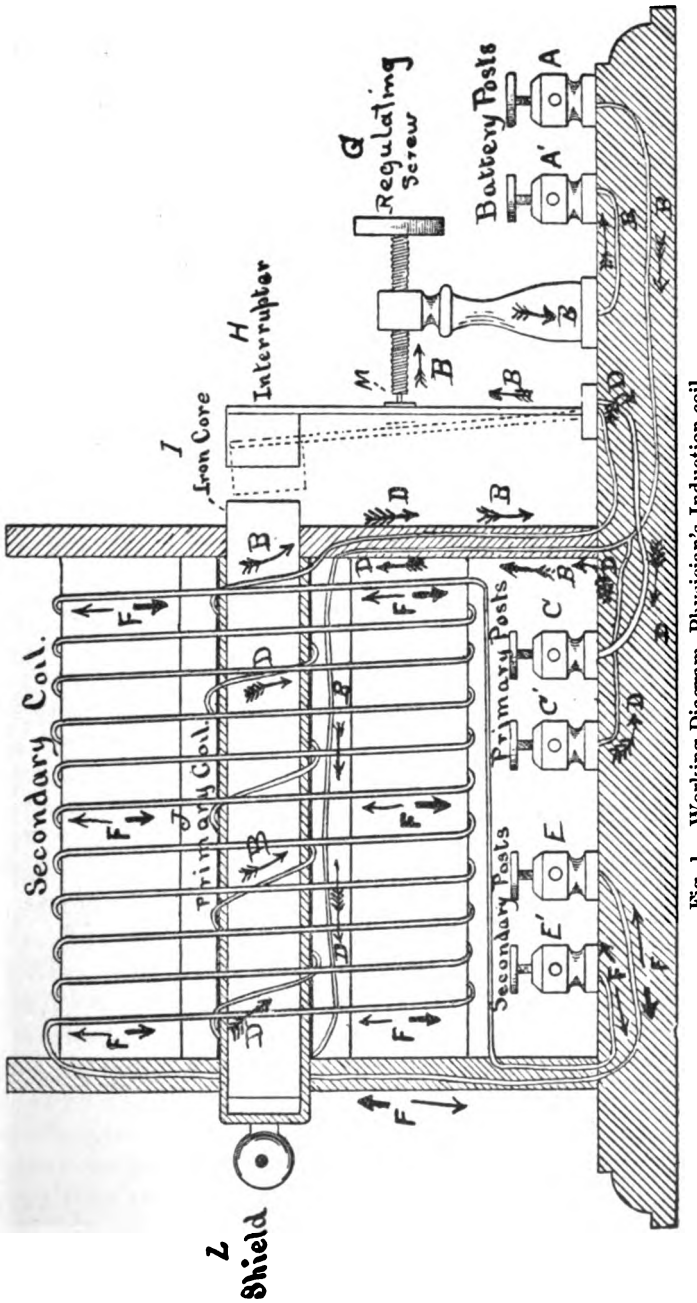

Fig. 1.—Working Diagram, Physician's Induction-coil.

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brator (Fig. 2). It has the same direction as the battery current, but differs from it in having less quantity, but higher electromotive force. Both its strength and electromotive force can be varied by moving the shield covering the core, or by changing the position of the core itself, if this is made movable.

THERAPEUTIC PROPERTIES OF THE PRIMARY INDUCED CURRENT.—This current has, in a feeble way, the properties of a direct or galvanic current. It is both electrolytic and phoretic to a slight degree, but its chief action upon the living organism is as an excitant to contractile tissue and to sensory nerves by reason of the interruptions which cause a sudden variation in potential. The suddenness of this change in electromotive force makes this current a

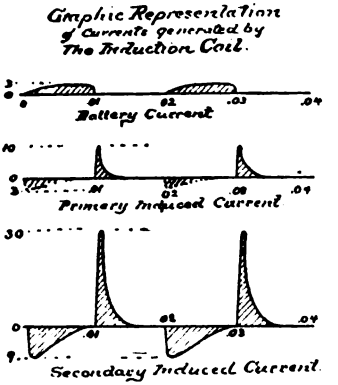

Fig. 2.

powerful stimulant for exciting muscular contractions and for arousing the action of sensory nerves.

MODALITY OF THE SECONDARY INDUCED CURRENT.—The secondary coil winding (*F F F F*, Fig. 1) is entirely distinct from the primary and has its separate terminals at the binding-posts (*E E'*). There are induced currents generated in the secondary coil both at the "make" and "break" of the battery current. The inductive effect of the "make" is due to the lines of force from the magnet cutting across the turns of the secondary coil. This current is comparatively slow in its increase to the highest potential because of the somewhat gradual development of these lines of force; it also meets the opposing force due to self-induction in the coil.

The induced current at the "break," on the contrary, because of

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sudden withdrawal of these magnetic lines of force, is more promptly developed to its greatest intensity, and, of course, is in the opposite direction from the current induced at the "make." The secondary-coil current then is a to-and-fro, or alternating, current, with the "break" a little greater in intensity, but shorter in duration, than the "make" current, while the frequency of the alternations or the number of periods depends upon the action of the vibrator, or interrupter. The electromotive force in this current is determined by the number of turns in the coil that are cut by the magnetic lines of force, and the quantity of current is determined by the resistance offered to its flow and the strength of the magnetic flux which induces it. The electromotive force, when a fine wire of many turns is used in the secondary coil, is much higher than that of the primary induced current, while the amount of current is correspondingly much less.

THERAPEUTIC PROPERTIES OF THE SECONDARY CURRENT.—The alternating character of this current prevents it from being either electrolytic or phoretic, while its physiological effects depend very much upon the structure of the coil and the frequency of the alternations. If the alternations are very frequent and the coil is composed of many turns of fine wire, the resulting current, though interrupted, begins to resemble in physical properties a sinusoidal current. The approaches to and departures from the highest and lowest potential in each period is, by this construction, made more gradual, and the effect physiologically is stimulating and yet not irritating. Its effect, therefore, is tonic and sedative on both motor and sensory nerves. It causes contraction of muscular structures both of the striped and unstriped variety, and excites movement in living protoplasm. The currents of the induction-coil are thus seen to be chiefly serviceable in stimulating the activities of the tissues within the range of their physiological action.

THE MAGNETO-ELECTRIC CURRENT.

THE MAGNETO-ELECTRIC MACHINE is an induced-current generator which was at one time quite generally used in therapeutics. The form commonly employed consists of two coils of fine wire, each having a soft-iron core and mounted in such a manner that they can be rotated near a permanent horseshoe magnet. In this manner the number of magnetic lines of force passing through the two cores is made to change continually, their polarity also changing, and cor-

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responding currents are set up in the coils according to the principles discovered by Faraday.

The two coils are so joined that the electromotive force generated in each reinforces the other.

MODALITY OF THE MAGNETO-ELECTRIC CURRENT.—In machines not employing a commutator the current is alternating in nature, each revolution of the coils corresponding to a single impulse in each direction. The rate of alternation is considerably slower than in the secondary-induction-coil current and in the sinusoidal current. The variations of electromotive force are not so abrupt as in the induc-

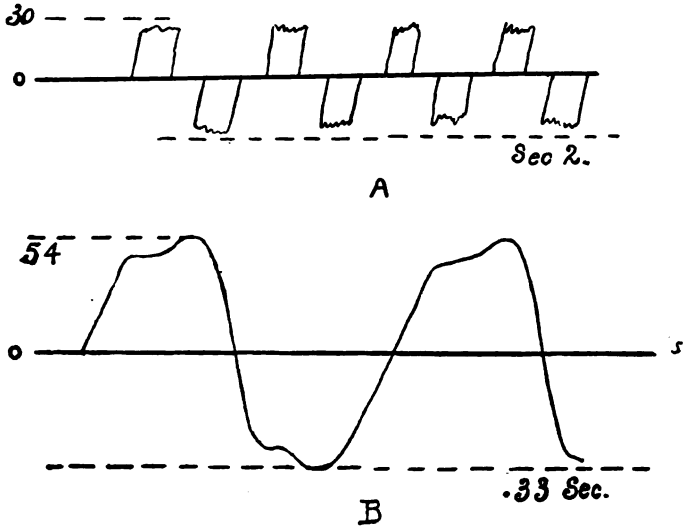

Fig. 3.—Graphic Representation of Currents Generated by a Magneto-electric Machine.

tion-coil, although some types are so constructed as to cause sudden variations of the electromotive force. The current from the magneto-electric generator may be represented graphically very much like the sinusoidal current, except that the undulations are much less regular. In some machines of this kind the current is made to flow all in one direction by means of a commutator. The current then resembles the direct, or galvanic, current, except that it is irregular, both as to amount of current and electromotive force.

THE SINUSOIDAL CURRENT.

By a *sinusoidal current* is meant an alternating induced current in which not only the rise and fall of potential or electromotive force

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of positive direction is immediately succeeded, without break, by an exactly corresponding rise and fall of potential of negative direction, but one in which this rise and fall in both directions would, if shown with accuracy in diagram, describe a sine curve. The accompanying illustration (Fig. 4) delineates this form of curve.

Mathematically considered, this curve may be defined as one resulting from two rectilinear motions at right angles to each other; the one being a uniform rectilinear, the other a simple harmonic motion. This last-named motion is one well illustrated by the common pendulum, which moves most rapidly at the middle of its swing, decreasing in rapidity as it approaches the ends. The figure represents diagrammatically a combination of these two motions. The equal spaces made by the vertical lines at the right represent the progress of the uniform rectilinear movement from left to right, while the spaces between the horizontal lines represent the simple

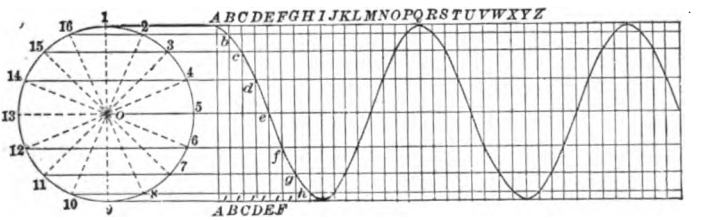

Fig. 4.—Sinusoidal Curve.

harmonic movement of sine displacements. These spaces on the vertical lines are obtained by dividing the circle at the left into 16 equal arcs and drawing horizontal lines through the points marking their boundaries, as 1, 2, 3, etc. Now, if we assume that this circle is made to revolve at right angles to the plane of the paper with the line *o*, 5, *e*, for its axis, one revolution of the circle will correspond to a complete vibration of a pendulum, and if, while revolving, the circle moves from left to right at a uniform rate along the axis *o*, 5, *e*, then the displacement of any point upon the margin of the circle from the middle line is proportioned to the sine of the angle of rotation on the circle. Thus, if we take the point 5 and rotate it through the arc 5, 6, the vertical displacement of the point 5 will be the sine of the angle of rotation, 5, *o*, 6. Again, the vertical displacement from 5 to 7 is the sine of the angle 5, *o*, 7. It will be seen that these sines correspond to vertical distances between the

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horizontal lines at the right of the circle, and that the diagonal lines in the parallelograms are but the resultant of these two movements of the circle.

The sine curve can be platted by completing these diagonal lines through one entire revolution of the circle.

MODALITY OF SINUSOIDAL AND SECONDARY-INDUCTION-COIL CURRENTS COMPARED.—The current derived from the secondary circuit of an induction-coil (Fig. 2) has been shown to be alternating, but the positive and negative alternations differ considerably in electromotive force, and the gradations from zero to the greatest difference of potential in either direction are not regular and uniform, but quite the contrary. Moreover, the secondary current of the induction-coil is interrupted, the time-interval occupied by the interruptions exceeding considerably that consumed by the passage of the current. In these respects the secondary current of the induction-coil differs from a sinusoidal alternating current in its physical properties, and these physical differences have, of necessity, a corresponding difference in physiological and therapeutic effects. By increasing the length and number of turns of the secondary coil and increasing the rapidity of the vibrations of the interrupter, the current derived from the secondary coil of the induction apparatus is made to approach more nearly in physical and physiological properties the sinusoidal current as at present used.

SINUSOIDAL AND MAGNETO MODALITIES COMPARED.—The magneto-electric apparatus likewise creates an alternating current. But the alternating current generated by this little machine, while it shows no interruptions when the coils are revolving, is yet quite irregular as compared with a sinusoidal current, since the lines of magnetic force emanating from the poles of the magnet cut the turns of wire in the coils as they revolve in such manner as to create no uniformity in the increase and decrease of the induced currents. It is, however, only in this feature of construction that this well-known magneto-electric machine differs from several of the sinusoidal machines that are now being manufactured for therapeutic work. In these latter the attempt is made, with more or less success, to secure such uniformity in the increase and decrease of the number of the magnetic lines of force that cut the coils as they revolve, that the electromotive force generated will describe the sine curve. This desirable result is the more nearly attained according as the permanent or electro-magnets used are so shaped as to furnish

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to the coils a strictly-uniform gradation in the strength of the magnetic field as they enter and leave it. Although the modern apparatus shows great progress in skill and workmanship, yet it is quite probable that no so-called sinusoidal machine has yet been constructed that describes accurately in its action the sine curve.

Alternating-Dynamo and the Sinusoidal-Current Modalities Compared.—The alternating-current dynamos now used so extensively for lighting incandescent lamps and for other industrial purposes furnish a current which is roughly sinusoidal, and this can be utilized by physicians who have access to it and have some form of controller suitable for modifying its strength and voltage. As the speed of these dynamos, while in action, is quite uniform, the number of alternations do not vary much, but the frequency is often much less than is wanted in therapeutic work, giving often but 124 alternations per second. It is convenient and oftentimes quite desirable to have an apparatus for the generation of a sinusoidal current so arranged that the operator can vary not only the frequency of alternations, but also the electromotive force and the current at will, and this is possible with some of the machines now manufactured.

Physiology and Therapeutics of the Sinusoidal Current.—There are several physical peculiarities possessed by the sinusoidal current which help to make its action on the body different from that of other forms of current. As has been seen from the foregoing description, the increase and decrease of potential in this form of current is gradual and uniform, and never abrupt nor sudden in its change. It is no doubt to this feature of the current that its peculiar action on the sensory and motor nerves is mainly due. The sensory and motor mechanism of the body is capable of adjusting itself to a considerable range of difference in external conditions without serious disturbance or discomfort, provided the change is not too sudden or violent. Even though there may be many periods of alternation of current per second and the electromotive force be quite high, yet the action of nerve and muscle is still capable of responding to such variations without disagreeable reaction, provided the change in strength is gradual. The number of alternations per second, the degree of electromotive force, and the quantity of current are, no doubt, each important factors in determining the physiological and therapeutic effects of this current; but these are not so peculiar to it as is this feature of uniformity in change. The effect of this

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special feature of the sinusoidal current is to lessen the disagreeable effects of electrical excitations, both on the sensory and motor mechanism. The same amount of stimulation to muscular action can be aroused as by any other equally-powerful means, without the accompanying pain and consequently without the shrinking and apprehensiveness on the part of the patient which other forms of excitation arouse. In this lies the chief advantage of the sinusoidal current over the current derived from the secondary induction-coil, while in many other respects these currents are similar in action.

For exciting to vigorous action muscular tissue, therefore, whether it be the voluntary or involuntary variety of muscle, the sinusoidal is the current *par excellence*. Such frequency of alternations can be used as will adapt the excitation to the requirements of the muscular structure. The comparative painlessness of the applications permits the use of greater electromotive force and more current than can be used either from the induction-coil or the primary battery; so that physiological action of the muscles is more thoroughly aroused than by the use of either of these other forms. The more nearly the curve of current conforms to the sinusoidal, the less will there be of effects resulting from polar action. Electrolysis and phoresis will be avoided and the changes brought about in the tissues to which the current is applied will be mainly those which are normal to their function, the effect of the current being to arouse that function to greater activity. When we consider how many of the normal processes of the body, such as assimilation, circulation, secretion, excretion, locomotion, etc., depend directly upon muscular tone and vigor, it will be seen at a glance what a wide range of therapeutic application is possessed by this form of current in the field of muscular excitation alone. It has been highly spoken of by many competent electro-therapeutists as a means of improving the nutrition and growth of muscular tissue whenever it is failing from lack of proper excitation.

General muscular weakness, local paralysis or paresis, lack of intestinal peristalsis, vaginal and rectal prolapsus,—due, in whole or in part, to lack of muscular tone,—and vasomotor debility are some of the conditions in which this form of current has proved especially beneficial.

It has been said that the sinusoidal current is remarkable for the little amount of sensory excitation it causes, and so permits powerful muscular contractions without discomfort. Further than

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this it serves to allay pain. It is as much, if not more, serviceable in this way than is the current derived from the secondary induction-coil of many turns. Apostoli and others have borne strong testimony to the fact that the greatest success they have attained with this form of current has been in allaying the pains that occur in connection with the pelvic organs. The pains caused by uterine inflammation, pelvic cellulitis, ovaritis, salpingitis, and congestion are quickly allayed by it. Neuralgic pains are relieved, and those of spinal irritation. Marked effects on tissue-metabolism have been noticed also, as indicated by increased consumption of oxygen and more rapid elimination of carbon dioxide. These effects are, in all probability, secondary to and dependent upon the increased muscular activity and analgesic influence of the current.

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MEDICAL PREJUDICE.

By Elihu B. Silvers, M.D., Rahway, N. J.

Jealousy is so human as to permeate to a certain degree every individual. It must be one of the inherent animal instincts, since no biped nor quadruped seems wholly exempt from its baneful influence. Such a spirit is a powerful lever to block the wheel of progress. The two inseparables in this world are cause and effect. There is a reason for everything. Man is the only animal with a chronic longing for the unattainable. Striving to gain things out of reach makes many succeed. We should not be satisfied with the gains of yesterday. Men who start on the downward path find in declivity everything suitable for rapid descent. To try to reach the topmost round of success means labor. The higher we ascend, the more rarefied the atmosphere. If we go fast, the more rapid the breathing. Too many in their overeagerness to pass their fellows have not first measured their physical resources and so exhaust themselves ere the goal is reached.

Prejudice and self-conceit cause the turning a deaf ear to suitable advice and the closing the eyes to careful observation; to the letting of well enough alone; and blocks the road to progress. Facts are stubborn things. We see vivid streaks of lightning; we know clouds are cleft and we listen for the expected thunder. The teakettle has had its music ever since fire was utilized. Men long existed and saw the spouting of steam and knew that water was boiling. The most stupid servant knows how to utilize this fact in all culinary processes, but it was left to one of many of this century to utilize this power for the purpose of navigation. The practical experiment was witnessed with incredulous eyes and failure prognosticated. The wonder now is why did not the world know it sooner! All rational discoveries are the simplest in detail. The most practicable in their fullest maturity are devoid of intricacies. With wood in its consumption, we descended from the earth's surface and substituted coal for the generation of force. Then we increased with economy the generation of power with less outlay of money and man's physical force. Now we have harnessed a more potent factor than steam and gotten the maximum of power from that subtle element, electricity. A jealous desire to arrive at the mine of teeming wealth has done

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most to make important discoveries. The alchemist in his futile search for an element to convert the baser metals into gold made other valuable discoveries, the utilization of which has given us the alkaloids of various medicants, and they have, though more slowly, enriched themselves and benefited mankind. Thus electric research as applicable to commercial enterprises has pointed out that the human frame could use this potent factor as a powerful assistant in the curing of disease. Lack of proper teaching in our medical colleges, where it should be one of the essential requirements, has largely, through the prejudice of those whose paid duty it is to use every avenue of true progress, been ignored in the maximum, medical potions alone getting their chief attention. To enumerate all the practical uses to which electricity can be applied, both surgical and medical, would take too much space; suffice it to say that no thoroughly competent practitioner can perform his whole duty to his patient who is not well versed in electrical science and does not give his patient the full benefit of this potent factor, either alone or in combination with the various medicants.

The establishment of the Electro-Therapeutic Society—the congregation of many who, by this association, compare results—is shedding its brilliant light into every dark crevice, and has so awakened interest that medical success is depending on its rays. *Per se*, it is all-powerful. In combination with suitable medicants it increases curative power. To the surgeon it points out the where—no longer groping in the dark. By the disintegration of hardened tissue obstructed roads are opened, and now the use of the knife to cut indurated urethral obstruction should be considered a relic of barbarism only perpetuated by prejudice. The influence of this society, it is hoped, will soon accomplish the beneficent result in every medical college of the setting apart of a distinct chair, suitably filled, where the subject of electricity will be efficiently taught.

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SOME THOUGHTS ON OLD CROOKES TUBES.

By Eugene R. Corson, B.S., M.D., Savannah, Ga.

Anyone who does much x-ray work must wonder at the endurance of the delicate glass bubbles which give us the x-ray. When we consider the high potentials used, and the electrical storm going on inside, the red-hot platinum reflector, and the tube itself at times uncomfortably hot, we are conscious of a "balance of power" which perhaps finds no counterpart in the field of physical experimentation.

In my x-ray work during the last three years I have used seven tubes and have broken one only; and, despite the molecular pounding they have been subjected to, the remaining six are still functionating with more or less success. Even the oldest one can still give a fair shadow of the hand.

The old age of a tube depends upon several conditions, some apparent and others still conjectural. Foremost stands blackening, due largely to reversals of the current. There is a metallic deposit from the electrodes. This was more marked when high-voltage alternating currents were used to energize the coil in the earlier experiments. The 110-volt direct current produces more blackening than the current from a storage-battery. I have always used light storage cells to energize my ten-inch coil, and the blackening has not been great, although, of course, sufficient to considerably impair the good working of the tubes. It is easy to understand how this metallic film must act as a curtain in obstructing the rays. After using the tube some time it becomes more and more difficult to pass the discharge through it. This has been ascribed to an increase in the vacuum. I have long thought that this did not explain the trouble, and that the cause or causes of this "hardness" must be looked for elsewhere. A reduction in the amount of residual gas inside the tube would be permanent, but the hardness is always at least temporarily overcome by heating the tube, and after the tube has been put away for months I find the hardness gone, and, while the efficiency of the tube has been much impaired, the inefficiency is due to other causes; so far as the discharge is concerned, it can easily be made to pass through the tube. I have worked tubes until they became "hard" and have put them away for cases when I needed the increased penetration of a higher vacuum-tube, and have found

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that they had quite recovered themselves. Now, this hardness from overwork is in strong contrast to that initial hardness where the tube has remained too long on the pump. I have just such a tube, and it has remained hard despite months of rest.

In the beginning of the hardening process the gentlest heating of the tube overcomes it. You picture to yourself a certain number of molecules which have temporarily gone out of commission. They have not been able to give up their charge, and may be sticking to the glass walls of the tube or lurking in out-of-the-way places. At least the gentlest heating overcomes the difficulty. You are now getting the best out of your tube; the definition is fine. Later, as this hardness increases, the rich Nile green of the cathodic illumination becomes fainter, and the shadows of the bones and soft parts are not so clearly differentiated. At this stage, if the glass insulation of the electrodes is not good, you can detect minute sparkings along the insulation up to the terminals. I have noticed this especially with the anode. Your tube is getting old and it can never do its best work again. In one of my tubes scales of the glass insulation have been thrown off. This is a more serious defect than the blackening. With this sparking there must be a waste of energy, and the potential at the terminals reduced by so much. This phenomenon early led me to believe that certain changes in the electrodes partly accounted for the hardness. It was early recognized that reversing the current through the tube helped to overcome the hardness. This certainly points to the electrodes as in some way inhibiting the discharge. In Roentgen's third communication he stated[1]: "As to the cause of the tube's becoming hard when sealed off from the pump, the explanation given above is the self-exhaustion of the tube owing to the discharge. But this is not the only cause; there are also changes at the electrodes which influence the result. What they consist in I do not know."

If after the tube has been working some time the current is cut off, and the tube is viewed in a perfectly dark room, there is seen the well-known phosphorescence of the glass most marked where the x-ray intensity is greatest, and the glass insulation of the anode shows a very strong phosphorescence. This has seemed to me to be due to a bombardment of the glass from pent-up molecules of air

[1] "Röntgen Rays." Memoirs by Röntgen, Stokes, and I. I. Thomson. Translated and edited by George F. Barker, LL.D. 1899. P. 34.

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between the metal conductor and the glass insulation. It is known that marked molecular changes take place in conductors through which powerful currents have passed, and it is probable that such changes taking place here influence in some way the discharge. Certain it is, too, that the electrodes are subjected to the severest strain. They practically bear the whole burden of the discharge, and they are therefore the most important consideration in the make-up of the tube. The difference in the efficiency of tubes is largely the difference in the electrodes, and you have but to compare the earlier tubes with the best made to-day to see this difference.

It seems to me quite possible that these higher-vacuum effects may be present without any reduction in the number of molecules of gas inside the tube. By an overcharging of the molecules they are not all able to unload. Those which hit the platinum fair and square do give up their charge, producing the electrical impulses which we know as x-rays, but there are undoubtedly many which "get lost in the shuffle" and are temporarily out of action. The good effects of heating the tube and a long rest would seem to point this way. It has seemed to me, again, that the function of the potash bulb was more in the way of helping the molecules to unload their charge than in the mere liberation of more molecules.

Another possible factor in this hardness has occurred to me. Prof. I. I. Thomson, of Cambridge, has shown that a dielectric traversed by the x-ray becomes a conductor. May not this, in conjunction with the fine metallic film deposited on the glass in the process of blackening, enable the current to partially leak through the walls of the tube, and that it is quite possible for these changes in the glass to reach such a point that all the current passes through the walls of the tube? Certainly my own experience leads me more and more to doubt the theory of higher vacuum as an explanation of the hardness. The hardness disappeared from all my tubes when they had had sufficient time to recuperate, and, as I have already mentioned, the only tube which remained unchanged was the one whose vacuum was too high in the beginning.

I have one tube which seems to show an overaction of the potash bulb, as though there were too much potash for the amount of gas in the tube. The vacuum was too high originally, and it was quite impossible to pass a discharge through it from my ten-inch coil. On gentle heating, however, the vacuum would be quickly reduced, too low for any usefulness, and working the tube five minutes

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would make it so hard as to stop all discharge again. There is no golden mean in this tube; it is too "hard" or too "soft" and passes from one condition to the other in a few seconds. I have even suspected, in this case, that the potash molecules themselves were thrown out. While the potash bulb is a necessity in the beautiful self-regulating tube af Queen & Co., it seems to be an unnecessary addition to the ordinary tube. Why cannot the potash be put in the main body of the tube itself opposite to the x-ray hemisphere? The tube would be less liable to break, and the potash could be, perhaps, more gradually and evenly heated.

There is still much to learn as to what takes place inside the Crookes tube, and there is, perhaps, as much room for improvement in its construction. It offers a fertile field for the scientific use of the imagination. It is cultivating metaphysics under glass. I have been informed by one who has made many tubes that he is puzzled every day. He will make a dozen tubes as nearly alike as it is possible for him to construct them, and perhaps six will show up perfectly at the testing. The Germans, to judge by their works, still use the simpler tubes, and the self-regulating tube of Queen & Co., which is such a marvel of ingenuity, has not taken the hold in Germany that we might have expected. The German tubes which I have seen are stronger, the platinum reflector is thicker, and round instead of rectangular: two points which the Americans may well copy. Although I have gotten good service out of the Queen tube, the simpler tube, if perfectly constructed, will give as good results in the long run, and, other things being equal, its simplicity should recommend it.

My experience leads me to regard the insulation of the electrodes as the most important factor in the construction of the tube. The earlier tubes largely failed here; they were short-lived. The electrode should be as short as possible and the insulation should be doubled; that is to say, the glass-insulated electrode should be further protected by a strong leading-in tube, separating it from the inside of the tube proper. The shorter the anode and the platinum reflector, the larger the x-ray segment, the more available the working area of the tube, and the less concentrated the blackening. A tube may be so constructed that the non-functionating part is reduced to a very small segment of the tube. It is gratifying to note how much progress has already been made in technical details; the efficiency and life of the tube have been more than doubled. The

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more efficient the tube in its working, the longer its life; such a tube will be found constructed on the principle which guided the making of "the one-hoss shay."

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MINUTES OF THE PROCEEDINGS

OF THE

TENTH ANNUAL MEETING

OF THE

American Electro-Therapeutic Association.

HELD AT THE NEW YORK ACADEMY OF MEDICINE, SEPTEMBER 25, 26, AND 27, 1900.

WALTER H. WHITE, M.D., of Boston, Mass., President.

FIRST DAY.—Tuesday, September 25th.

Morning Session.—The meeting was called to order in the New York Academy of Medicine at 10.15 A.M. by the president, Dr. Walter H. White, of Boston.

ADDRESS OF WELCOME.

By Hon. Randolph Guggenheimer, Acting Mayor of New York City.

Mr. Chairman, Ladies and Gentlemen: It gives me very great pleasure to be present here this morning, to welcome the American Electro-Therapeutic Association to the city of New York, which I have the honor to represent, in my capacity as President of the Council.

I am glad that you have selected the metropolis as your place of meeting for this year, because I believe, with most of my fellow-citizens, that it is the best place in the world for work and enjoyment. Indeed, we are tempted by the marvelous growth of our city in population, in commerce, in scientific research and accomplishments, in fact, in the general sphere of business and professional activities, to indulge in unstinted pride.

It is almost startling to consider the fact that only a short time ago, as measured by the standards of history, the spot where we are assembled this morning was desolate forest, trodden only by the feet of the savage.

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To-day the island of Manhattan represents, as one of the boroughs of Greater New York, a magnificent centre and example of those industries which mark the advance of civilization.

The object of your society appeals to everyone who realizes that the best gifts conferred upon the human race are strength to work and vitality to endure.

It is not necessary for me, because I am not an Electro-Therapeutic expert, to dilate this morning upon the work of your association. It will be sufficient for me to say that the object for which you have been incorporated challenges the earnest consideration of all scientific minds.

The benefits conferred upon surgery by the discovery of the Roentgen ray are only the first of many other secrets of the universe which will be interpreted by the science of the twentieth century.

Again, I beg to welcome your association to the city of New York and to assure you that you will receive a most hearty welcome from this cosmopolitan community, not the least admirable characteristic of which is an unbiased mind in the investigation of truth.

Dr. C. R. Dickson, of Toronto, replied as follows:—

In listening to the well-chosen remarks of your worthy Acting Mayor I could but wish that the pleasant duty of replying to this charming address had fallen upon one better qualified to fittingly reply. Probably I was chosen because of the feeling of international courtesy which is so much abroad just now. This has been much in evidence of late in the disturbance in China, where the troops of Great Britain and those of the United States have fought side by side. I hope if they have to fight at all in the future they will be found fighting together, the world over, for Freedom and for Progress. Although this is an American association, you very properly have members in other lands, for Science should know no boundaries, and Progress should be universal. Facts which are truths in America should be true in every land.

Mr. Guggenheimer has spoken of the time when New York was but a forest. It is a forest still, I think, but now a forest of tall chimneys and stately spires, temples of learning and art, hives of human industry rising stupendous, and palatial residences. He has told us that New York is made up of Boroughs. At the present time it seems to be made up largely of burrows under the ground, due, by the way, to fresh inroads of electricity. We are always glad to come

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to your city, and doubly so when we are met with such a hearty welcome as has just been accorded.

We come to these meetings as exponents of one of the latest and most practical developments of the science of medicine. Electricity in its various departments is making tremendous strides all the world over, and nowhere more than in this city. As electro-therapists a great responsibility is laid upon us, for we must not be content with present achievements, but with ceaseless energy and tireless perseverance press onward, and show the world that we are worthy of our calling. In our eager and enthusiastic quest let us see to it that none of us does aught to bring discredit on the fair name of the American Electro-Therapeutic Association.

Mr. Mayor, I thank you for your very hearty greeting.

Dr. W. T. Bishop, of Harrisburg, moved that a copy of the address of the mayor be requested for publication in the Transactions, and that the mayor be given the privileges of the floor during this meeting. Seconded by Dr. G. B. Massey, and carried unanimously.

ADDRESS BY LOUIS FAUGERES BISHOP, M.D.

Your committee has asked me to say a few words of welcome to the American Electro-Therapeutic Association. Nothing can be more pleasant than to welcome to the use of the Academy of Medicine an association of gentlemen who have come together from all parts of the country to advance our knowledge of therapeutics. The need of the scientific study of electro-therapeutics is appreciated better by no class of men than the general practitioner. You will pardon me if my remarks are from the point of view of the general medical diagnostician and practitioner.

It will no less be acknowledged by you than it is contended by me that the application of electricity, which is generally made by physician to patient, has little effect beyond those results that would come by any therapeutic proceeding involving manipulation of the parts. The electrocautery owes its effects, not to electricity, but to heat. In the electrocautery the current does not pass through the tissues at all, so that its use can hardly be deemed an electro-therapeutic measure. The effects of currents which are short of the cauterizing intensity will form, no doubt, a most interesting part of your discussion, and it is upon these effects that as physicians we

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are most interested. The application of electricity to functional disorders—and by these I mean diseases in which the pathology is obscure and the symptoms prominent—are valuable in certain cases, but how valuable the actual results are may well form a question of debate.

The trouble in the development of electro-therapeutics has been that they have been carried out, too often, by those who either, on the one hand, were ignorant of disease, or who, on the other hand, were ignorant of electricity.

When men of various occupations or divisions of the same occupation come together there are sure to be differences of opinion, which, when threshed out, benefit all. A mutual-admiration society —like some of our smaller semisocial specialistic bodies—is delightful and entertaining, but when the members have threshed over a subject with expressions of views that meet the approval of all, the members are often more pleased than benefited. Divisions of men with similar experience and points of view get so far to agree on certain subjects that their meetings often lack interest. This is not only true of specialists as a class, but of general practitioners as a class, and it seems to me a pity when the small society replaces the general medical meeting, where all sides are represented.

The special meeting has its advantages, but its members should not lose their interest in general work. The division of medicine into specialties has not been at all logical. First, it has been divided into general medical and surgical diseases. Then, again, it has been divided into diseases of special organs: as diseases of the nervous system, diseases of the stomach, the eye and the ear, etc. Third, it has been divided as to age,—diseases of childhood and diseases of old age. Once again, it has been divided according to the kind of treatment required, into hydro-therapeutics, electro-therapeutists, operating surgeons. Besides these there are many other shades of specialism. It seems to me that the specialist in therapeutics is the one who must most be on his guard against those practices which bring medicine into disrepute. The temptation to treat all comers by the one form of therapeusis must, indeed, be great. Anyone subjected to a course of electro-therapeutics should have the advice of a well-grounded general practitioner of medicine. This may be an electro-therapeutist himself; but if such a one devote himself entirely to electro-therapeutics, or be without medical education, his judgment would be liable to be biased by a lack of perspective. The natural history

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of disease must be known in order to judge fairly of any results of treatment, and true scientific evidence is only that which takes into consideration the effect of auxiliary measures, of elapse of time, and of the moral effect common to all treatment.

Fortunately the American Electro-Therapeutic Association associates the physician and the electrician, and we may expect the two professions to modify the views of each so that the truth will prevail. Science demands that every fact shall be illumined, that every theory, however absurd it may appear, shall have the opportunity of vindication. Science abhors persecution. It grants to every man the right to believe and act according to his conviction, so long as he does not interfere with the rights of others. It is upon these principles that the Academy of Medicine approaches all subjects pertaining to the practice of medicine. Its meetings are open to the presentation of all views, which must stand or fall in open discussion. This Electro-Therapeutic Association is destined to add to the knowledge of therapeusis, and the Academy of Medicine feels that granting the use of their building, therefore, has been a privilege.

Dr. W. T. Bishop moved that a copy of this address be requested for publication in the Transactions, and that Dr. L. F. Bishop and his fellow-members of the Academy be cordially extended the privileges of the floor. Seconded by Dr. Massey, and carried.

ADDRESS BY REV. H. NEWMAN LAWRENCE.

The fact that you have asked me, a clergyman, to deliver a short address at the commencement of your proceedings is, I take it, an indication that you are not among those who hold that there is necessarily antagonism between Science and Religion. I, therefore, welcome the duty you have imposed upon me and only regret my inability to do justice to the occasion.

There is no antagonism between Science and the Church of God. Both hold strong to the Truth, and therefore should work together, hand in hand. The study of Electro-Therapeutics — one of the highest developments of modern Science—is extremely interesting and absorbing. The pursuit of it brings us sooner or later face to face with the great ultimate Cause, and therefore should lead us to deeper reverence of the Great Architect of the Universe and His laws. As man invents and discovers, too often his success in this

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direction induces him to regard himself as a creator also, forgetting that in reality he only makes use of God's materials to produce new combinations of things which he can neither create nor destroy. Without the God-given materials from Nature's workshop, or, more correctly, God's treasure-house, man could invent nothing and discover nothing; and, without using the brains which he can neither create nor vivify, he could conceive nothing.

With these good gifts, using his brains to reason with, man is privileged to discover or unveil that which, though hidden, already exists, and, by using materials new and old from Nature's divine store-house, to produce fresh combinations and transformations thereof for the general good of mankind.

Thus, ever standing upon the threshold of the unknown, does the scientific investigator, with reverence and awe, press forward in the glorious work of unveiling and applying to the good of his fellow-man new revelations of Scientific Truth.

To this association, therefore, whose sphere is one of the noblest which falls to the lot of man,—the cure of disease and the relief of suffering by means of the latest developments of Scientific Truth,—I, as a Minister of the Gospel of Truth, in this great metropolitan city, extend the right hand of fellowship and bid you Godspeed in your work.

Dr. W. T. Bishop moved that the society request a copy of these remarks to be included in the Transactions. Seconded by Dr. Massey, and carried unanimously.

Communications were then read by the secretary.

Report of the Committee of Arrangements.—Dr. Robert Newman, chairman of this committee, referred to the program as evidence that the members would be kept busy from eight o'clock in the morning to eleven at night. He then gave detailed information concerning the various entertainments that had been provided.

Reports of Standing Committees.

On Induction-coils and Alternators.—This committee reported progress, and, on motion of Dr. Massey, the report was received, and the committee continued.

On Electrodes.—Dr. Charles R. Dickson, of Toronto, chairman, presented a report in writing, which was supplemented by remarks

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by Mr. Brown, and discussed by Drs. Massey, Nunn, White, Morse, and Mr. Brown.

The report was, on motion, accepted and ordered to be printed in the Transactions, and that the committee receive the thanks of the association.

It was also moved and carried that the standard tip recommended by the committee be adopted by the association.

On Cataphoresis.—Mr. J. J. Carty, of New York, chairman, reported progress.

On motion of Dr. Massey, seconded by Dr. Nunn, the thanks of the association were tendered to the various telephone companies who, through Mr. Carty, had extended free telephone service to the members during the meeting.

A paper entitled "Electro-Therapeutic Sins" was read by Rev. Newman Lawrence, of Stapleton, N. Y., and discussed by Drs. Massey, Watson, Bill, Newman, Dickson, W. T. Bishop, Brower, and Silvers.

Dr. Silvers moved that the secretary be instructed to give a copy of this paper to the Associated Press. The motion was adopted unanimously. The president appointed Dr. Silvers, Mr. Brown, and the secretary as a committee to attend to the subject-matter of the resolution.

Adjourned at 1 P.M.

At 2 P.M. the members visited the automobile headquarters of the New York Electric-Vehicle Transportation Company.

On motion, a vote of thanks was tendered President H. Sanderson, and the chief engineer for their kindness in showing the works, and the members joined heartily in wishing the company long life and prosperity.

The next place visited was the Columbus Telephone Exchange.

Afternoon Session.—The session was opened at 4.15 P.M., the president in the chair.

Discussion on Electricity in Tuberculosis and Present Modes of Treatment.—Papers were read as follows:—

"Etiology of Tuberculosis: its Course and Termination," by Dr. S. A. Knopf, of New York City, present by invitation.

"The Modern Treatment of Pulmonary Tuberculosis," by Dr. M. J. Brooks, of Stamford, Conn., present by invitation.

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"Electric Light in Tuberculosis," by Dr. Charles O. Files, of Portland, Me.

"Electric Light: its Physiological Action and Therapeutic Value in Tuberculosis of the Throat and Lungs," by Dr. Wolff Freudenthal, of New York, present by invitation.

"Report of Practical Value of Crotte's Method and of the Methods of Others Who Advertise Cures," by Egbert le Fèvre, M.D., of New York, present by invitation.

Those taking part in the discussion were: Drs. Hatch, Massey, Reyburn, and Morton.

On motion of Dr. William J. Morton the president was requested to appoint a committee of three to report on the electro-physics of the Crotte method, and in this connection to read the report submitted in French to this association by Dr. Hatch. Seconded by Dr. Reyburn, and carried unanimously.

The association adjourned at 6.30 P.M.

Evening Session.—The association was called to order by the president at 8.15 P.M. Papers were read as follows:—

"A Plea for the Better Application of Electricity in Therapeutics," by Dr. J. Griffith Davis, of New York City.

"Some New Appliances for X-ray Work," by E. W. Caldwell, E.E., of New York. Discussed by Dr. Files.

"Combined Electrization, or Galvano-faradization," by A. D. Rockwell, M.D. Discussed by Drs. Massey, White, Livingston, Dickson, Nunn, and Mr. Brown.

"Gleanings in the Field of Electro-Therapeutics," by Charles O. Files, M.D., of Portland, Me.

Adjourned at 9.50 P.M.

SECOND DAY.—Wednesday, September 26th.

Executive Session.—The meeting was called to order by the president at 9.55 A.M.

The secretary read the minutes of the last executive session, and, on motion, they were approved.

He then read the report of the meeting of the council, held the previous evening. The following persons were recommended for membership: Drs. F. Koempel, of New York City; F. F. Repetti, of Washington, D. C.; J. F. Huntley, of Oneida; S. F. Wilson, of

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Montreal, Canada; S. W. Baylies, of Buffalo; E. V. Delphey, of New York City; D. T. Millspaugh, of Paterson, N. J.; and William Miller, of Riverside, Cal.

They were unanimously elected members.

A communication was read from Prof. Félix la Torre, of Rome, Italy, sending a paper entitled: "Treatment of Uterine Diseases with Electricity"; also a letter of regret from J. Inglis Parsons, of London, at his inability to be present.

The secretary announced that he had received a letter from the *Electrical Review*, of London, asking if it would be possible to receive any or all of the papers read at this meeting. A communication was then read from Richmond, Va., asking what formality must be gone through to secure Richmond as the next place of meeting of the association; also one regarding holding the next meeting in Cincinnati; and a similar communication from the mayor's office, Niagara Falls, setting forth the desirability of that place for the next meeting of the association.

A letter from Dr. Ernest Wende, of the Health Department of Buffalo, was read, inviting the association, on behalf of the mayor, Dr. Conrad Diehl, to hold its meeting in 1901 at Buffalo. Similar letters of invitation were read from the Chamber of Commerce at Detroit, and from the Commissioners of Reservation of Niagara Falls, supplementing the invitation of the mayor of that city.

Dr. W. T. Bishop moved that, if the paper of Professor la Torre be printed in the Transactions, the secretary be requested to furnish the author with the proof-copies desired, and also send a copy to the *Electrical Review*, of London. Seconded and carried.

Nominating Committee.—Drs. G. B. Massey, A. T. Livingston, and R. Reyburn were appointed on this committee.

Auditing Committee.—Drs. W. T. Bishop and Maurice F. Pilgrim were appointed an auditing committee.

The Executive Session adjourned at 10.25 A.M.

Scientific Session.—Discussion: Electricity in Gynæcology and the Present Reluctance of Gynæcologists to Use Electricity.—Papers were read as follows:—

"The General Office-work of a Gynæcologist," by Dr. F. H. Morse, of Melrose, Mass.

On motion of Dr. Reyburn, seconded by Dr. Newman, the papers of this group were ordered read before the discussion.

"The Morton Wave-current: a Valuable Addition in Electro-

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Therapeutics," by Dr. W. B. Snow, of New York City. In the absence of Dr. Snow, his paper was read by Dr. Dickson.

"Nervous Diseases Peculiar to Women," by Dr. G. Betton Massey, of Philadelphia.

"Use of the Continuous Current and Electrolysis," by Dr. Robert Newman, of New York City.

The papers in the symposium were discussed by Drs. Massey, Reyburn, Morton, Hall-Brown, Files, Newman, Wilson, Nunn, and F. B. Bishop.

Adjourned at 1 P.M.

At 2 P.M. the members met, by invitation, at the power-house, Ninety-sixth Street and First Avenue, where, through the courtesy of Mr. M. G. Starrett, chief engineer, they were shown this interesting plant under the guidance of Mr. William A. Low, the engineer in charge.

Mr. Low said: This is the largest plant of its kind in the world, having 70,000 horse-power. It was necessary in building a foundation to drive 78,054 piles. The chimney is the tallest in this country by five feet, and contains 3,400,000 bricks. Over the engine-room are the offices and living apartments. The boilers are arranged in three tiers, and have a rating of 250 horse-power. Over the boiler-room are two large coal-bins holding 4500 tons each. The coal is taken from the river by means of buckets, and is delivered into a hopper; from there it passes through a weighing machine, and afterward is conveyed by a series of buckets to its destination. Each furnace is fed by an automatic stoker. Ash-conveyers empty the ashes into the empty coal-buckets, and by these they are carried out of the building and deposited on the docks. The coal is not handled by hand from the time it comes in on the boats until it is taken away in the form of ashes. When finished, the boiler-room will contain 11 engines of the marine type. The shaft of the engine weighs 35 tons. The 28-foot fly-wheels, weighing about 150 tons each, are built up of inch-plates riveted together cold. On the first floor is one of the substations. The current is generated at 6600 volts, and is distributed to the various substations throughout the city. This power-house was originally intended to operate only the Metropolitan Railway lines, but recently the Third Avenue and the Union Railway lines have come under the same management.

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The next visit was made to see the cable and machinery of the Brooklyn Bridge, by invitation of Mr. Martin, chief engineer.

Afternoon Session.—The meeting was called to order by the president at 4.15 P.M. A paper entitled: "Spark-Gap Currents, viz.: Franklinic, Interrupted, Static Induced, and Wave Currents," was read by Dr. W. J. Morton, of New York. Discussed by Drs. Herdman, Massey, Rockwell, F. B. Bishop, Hall-Brown, Dickson, Cleaves, White, and Morton.

Dr. Morton moved that a committee be appointed to investigate these currents and the questions of priority raised. Adopted.

Evening.—Executive Session.—The meeting was called to order by the president at 8.20 P.M.

The Presidential Address—"Some of the Needs of this Association," was delivered by Dr. Walter H. White, of Boston, Mass.

Dr. Brower moved that as much of this address as referred to the possible union with the American Medical Association be referred to a special committee of three to be appointed by the chairman. Seconded by Dr. Josephine Griffith Davis.

Dr. Robert Newman moved to amend by referring the President's Address to the committee, the latter to report to the association to-morrow. Motion carried as amended.

Drs. W. T. Bishop, D. R. Brower, and W. J. Morton were appointed on this committee.

The report of the Auditing Committee was received and accepted and the committee discharged.

The report of the secretary, Dr. George E. Bill, was presented.

Dr. W. T. Bishop moved that the report be accepted and a vote of thanks extended to the secretary for his efforts in collecting dues. Seconded by Dr. Dickson, and carried.

Dr. W. T. Bishop then moved that an *honorarium* of $50.00 be paid the secretary as a token of appreciation of his work. Dr. Massey, in seconding the motion, called attention to the fact that at the last meeting a resolution had been passed voting this sum to the secretary. The motion was carried unanimously.

The report of the treasurer was read by the secretary.

On motion of W. T. Bishop, seconded by Dr. Massey, the report was accepted, and a vote of thanks extended to the treasurer.

Report of Nominating Committee.—Dr. Massey reported for this committee as follows:—

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President.—Dr. Ernest Wende, of Buffalo.
First Vice-President.—Dr. F. H. Morse, of Melrose, Mass.
Second Vice-President.—Dr. D. R. Brower, of Chicago.
Secretary.—Dr. George E. Bill, of Harrisburg.
Treasurer.—Dr. R. J. Nunn, of Savannah.
Executive Council.—Drs. F. B. Bishop and W. H. White.

Dr. W. T. Bishop moved that the secretary be instructed to cast an affirmative ballot for the election of the officers as presented in this report. Seconded and carried, and they were declared duly elected.

The Committee on Nominations also suggested Buffalo as the place for the next meeting, the date to be left to the Executive Council.

On motion, the Executive Session adjourned at 9 P.M. until the following morning.

Scientific Session.—By invitation, an address on "Methods of Generating and Transforming Electric Currents for Therapeutic Uses," was made by Mr. Charles T. Child, E.E. In the absence of Mr. Child the address was read by Dr. Dickson.

On motion of Dr. Massey, seconded by Dr. Brower, a vote of thanks was tendered to Mr. Child for his contribution.

Papers were read as follows:—

"Illustrations of the Value of the Cataphoric Method in Cancer," by Dr. G. Betton Massey, of Philadelphia. Discussed by Drs. Morton, Rockwell, Wilson, and Massey.

"The Cause of Some Cases of Neurasthenia, and Their Treatment," by Dr. Francis B. Bishop, of Washington, D. C. Discussed by Drs. Rockwell, White, Brower, Wilson, Cleaves, and Bishop.

"X-ray Photographs," by Dr. E. R. Corson, of Savannah, Ga.

Adjourned at 11.05 P.M.

THIRD DAY.—Thursday, September 27th.

The meeting was called to order by the president at 9.55 A.M.

The Committee on the Crotte Method of Treatment was announced as being composed of Drs. W. J. Morton, R. Newman, and E. Heuel.

On motion of Dr. Wende, seconded by Dr. Pilgrim, the reading of the minutes of yesterday's proceedings was dispensed with.

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The Committee on the Wave-current was announced as consisting of Dr. W. J. Herdman, chairman; Mr. W. T. Jenks, E.E.; and Mr. A. E. Kennelly, F.R.A.S.

Dr Baylies moved that the association instruct the committee to restrict its work to the investigation of the nature of this wave-, or displacement, current. Seconded by Dr. F. B. Bishop.

Dr. W. T. Bishop moved to amend by adding that this investigation be carried on without expense to the association. Seconded by Dr. Files.

Dr. Files moved to still further amend by instructing the secretary to find out first from Dr. Morton whether it had been his intention that the committee should investigate the question of priority or simply the nature of the wave-current. Seconded by Dr. F. B. Bishop. The motion was carried, and the secretary was instructed to carry out its provisions.

The Committee on Necrology—consisting of Drs. Morton, White, and Bill—presented its report on the death of Dr. Apostoli.

Resolutions passed by the American Electro-Therapeutic Association regarding the death of Dr. Georges Apostoli, of Paris, France.

Resolved, that we, the American Electro-Therapeutic Association, hereby record our sincere sorrow at the death of Dr. Georges Apostoli; that his death has deprived Electro-Therapeutics of one of the foremost of its able defenders, one of its highest types of practitioners, and one whose work was a direct gift to humanity of a valuable procedure for the cure of disease.

In his death we, as electro-therapeutists, and the medical profession, as a whole, have suffered a distinct loss.

In recognition of our sorrow and in admiration of his career as a physician, we resolve that this resolution be spread upon the minutes of this association, and be transmitted by our secretary to Dr. Apostoli's family.

(Signed) Dr. William J. Morton, *Chairman.*
Dr. Walter H. White, *President.*
Dr. George E. Bill, *Secretary.*

On motion of Dr. W. T. Bishop, seconded by Dr. Files, the report was accepted and a memorial page in the volume of Transactions was set aside for this report.

Drs. F. H. Morse, W. H. White, and G. E. Bill, who had been

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appointed a committee to draft resolutions on the death of Dr. Perkins, presented the following resolution:—

Resolved, that in the death of Dr. Enoch A. Perkins, of Boston, Mass., deceased member of this association, the latter desires to express its sense of his worth as a practicing physician, in the field of Electro-Therapeutics, its pleasure in the memory of his Fellowship, with its deepest feeling of sympathy to be extended by the secretary to his widow and family.

That a copy of these resolutions be introduced in the Transactions of 1900.

That a copy signed and sealed by the committee be transmitted to the family of the deceased.

(Signed) FRED. H. MORSE, M.D.
WALTER H. WHITE, M.D.
GEORGE E. BILL, M.D.

On motion of Dr. W. T. Bishop, seconded by Dr. White, the report was received and ordered incorporated in the Transactions, and a copy thereof sent to the family of Dr. Perkins.

Committee on President's Address.—Dr. W. T. Bishop presented this report. On motion, the report was accepted.

Dr. R. J. Nunn then moved that any new member admitted before the next meeting shall have half of his dues refunded. Seconded by Dr. W. T. Bishop, and carried unanimously.

Amendments to By-laws Proposed a Year Ago. — Dr. Ernest Wende moved, and Dr. Files seconded, that, acting on the suggestion of Dr. F. B. Bishop, Article IX of the constitution be amended by striking out the words "two months before the first day of the annual meeting."

The chairman ruled that this amendment does not operate until after the adjournment of this annual meeting.

Dr. W. T. Bishop moved that the meeting next year shall begin on the second Tuesday of September. Seconded by Dr. Reyburn.

Dr. Dickson moved to amend by making this motion a recommendation to the Executive Council. Seconded by Dr. Reyburn, and carried as amended.

Dr. W. T. Bishop moved a vote of sincere thanks to the fellows of the association residing in New York, to the New York Academy of Medicine, and to the medical practitioners of New York City for

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the entertainment they had furnished the association. Seconded by Dr. Massey, and carried.

Dr. F. B. Bishop moved a vote of thanks to those gentlemen in the various cities who had complimented the association by sending invitations to meet in their cities, and requested that the secretary state that the association had decided that it would be best to meet in Buffalo on account of the exposition. Seconded by Dr. W. T. Bishop, and carried.

Dr. W. T. Bishop moved a special vote of thanks to their old-time friend and honored fellow-member, Dr. Robert Newman, for his interest in the association. It was carried unanimously by a rising vote.

Dr. Newman, in responding, said that he felt very much honored by this kind appreciation of his work. He accepted all that had been said with the wish that everyone present should work to have electro-therapeutics brought to a position where it would be truly appreciated by the medical profession at large and the general public. He urged the members to do individual work toward increasing the membership and strength of the association.

Dr. W. H. White moved a vote of thanks to the Ladies' Auxiliary for the decoration of the room and for the entertainment which they had provided for the visitors. Seconded by Dr. Bill, and carried unanimously by a rising vote.

Dr. Massey moved that a vote of thanks be accorded the president, secretary, and other officials who had done so much to make this meeting a success. Seconded and carried by a rising vote.

Dr. Ernest Wende, of Buffalo, the president-elect, was then conducted to the chair. Dr. White expressed his pleasure at handing over the gavel to his successor, and the latter replied as follows:—

Mr. President and Fellows of the Association: I assure you that I appreciate fully the honor bestowed upon me in selecting me as your next presiding officer. I also appreciate the recognition in your selection of Buffalo for the second time as your place of meeting. It is, indeed, a double honor, and a stimulus to the next president to do at least as well as his predecessors. Regarding the exhibition, I shall only say that I can promise those who come that they will not be disappointed with the electrical exhibit. As I am compelled to leave the city, I shall ask Dr. White to continue in the chair to the conclusion of the present session.

Executive Session adjourned at 11 A.M.

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Report from the International Electrical Congress in Paris.—Mr. R. G. Brown: As you know, the congress met last July in the Faculté de Médecine in Paris. There were 300 or 400 members there, many of them well known to us. M. Tripier was the president of the congress. M. Rivière had the largest establishment in Paris that I visited. I believe I was the only American there. The president, on opening the session, stated that he preferred to select six gentlemen, one of whom was to preside each day. In this way I had the honor to preside on the fifth day. They began at half-past nine in the morning, and continued until about two o'clock. The session was resumed at four o'clock. The evenings were given up to social pleasures. All of the papers were strictly limited to ten minutes. Everyone participating in the discussion was requested immediately to write out his remarks for the secretary. Some of the papers were printed in advance, and copies placed in the hands of the members. One paper I have here—a contribution from the Roentgen Institute at Stockholm on the treatment of cancroid (true cancer) by the application of the x-rays. One case reported was treated July and August, October and November, and February and April, once daily for most of this time. Another paper was on locating foreign bodies by means of the x-ray. A seismograph was also shown. The object of this instrument was to give rise to vibrations and apply the same to various parts of the body. One of the papers which excited a great deal of interest was on the high-potential high-frequency current. The favorite machine for this purpose is one manufactured by Gaiffé. Static machines are apparently not very popular, probably because they are of inferior make. Moitier had a battery and condenser which was interesting. A current of 15 milliampères from the battery direct produced a certain sensation, but if 30 milliampères were discharged through the condenser the sensation was the same as at the first. Electric baths caused a good deal of attention, but were quite generally objected to on the ground that they were time-consuming. Rivière's establishment is very extensive, consisting of a suite of eight or nine rooms, each room being devoted to a special form of application. His regular fee for each treatment is 2 louis, or $8.00. The day before the congress opened the President of the Arrangements invited thirteen of us to take dinner with him, and we were entertained in royal style. On the last day there was a grand dinner, and almost everyone went, paying $4.00 each. The mayor of Paris invited the delegates to the reception, as did also

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the President of France. There was another reception at the Luxembourg. The entertainment was carried out on a lavish scale.

On motion of Dr. W. T. Bishop, seconded by Dr. Reyburn, the secretary was instructed to cast a ballot for the election of Dr. William S. Whitwell, of New York City, to membership.

Adjourned at 1 P.M.

After the adjournment of the association the members and accompanying ladies were entertained by a carriage-drive, as guests of the Committee of Arrangements. The route was up Fifth Avenue and through the park and Riverside Drive to Grant's Mausoleum, which was inspected, after which a visit was made to the library of Columbia College and to St. Luke's Hospital.

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PRESIDENT'S ADDRESS: SOME OF THE NEEDS OF THIS ASSOCIATION.

WALTER H. WHITE, M.D.

Fellow-members of the American Electro-Therapeutic Association: It is with pleasure that, as your president, I greet you at this, our tenth, annual meeting. Can you realize that it is so short a time since, in response to a circular issued in the summer of 1890, this association was organized: an association of regularly-graduated physicians, devoting their attention to the special study of electro-therapeutics, and which held its first annual meeting in Philadelphia, September, 1891, with our esteemed colleague, Dr. G. Betton Massey, as its first president?

Electricity is one of the remedial agents in our armamentarium which is still largely neglected by the bulk of regular physicians. It is generally manipulated by charlatans, who, without any preparation or study in the application of this most potent agent, essay to cure all ills, often with the crudest sort of apparatus. That they do succeed in some cases only proves its efficacy; and if handled in a proper and scientific manner it is one of the greatest adjuvants in the realm of medicine.

Like other branches in therapeusis, we believe that, by giving special study to this remedial agent, we can get better results and give greater satisfaction to our patients than by the use of other means. There is, in the field of medicine, many specialties, and why not one devoted to electro-therapeutics? As most, if not all, of us are members of the American Medical Association, I, for one, would like to see a committee appointed to consult with the governing officers of that association, so that this society might be recognized as one of the subdivisions or branches of that association.

We could then have our meetings at the same time and place, thus affording them an opportunity to get acquainted with our work and give us a chance to attend both meetings, and possibly giving us a larger attendance at our meetings.

Now, the field of electro-therapeutics is large in itself, and those of us who have made use of it for twenty or more years realize that there is yet much to learn.

From the magneto-electric machines, single-plate friction-machine (in its day a most fickle instrument) and batteries with cells of infinite variety, we have come to deal with alternating and

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continuous currents generated in such large quantities: running our cars, lighting our cities, cooking our food that "they are as sick that surfeit with too much." We now need transformers, controllers, etc., to reduce both voltage and ampèrage; to enable us to administer it in comparatively small amounts varying from $^1/_{10}$ milliampère in nervous diseases to a full ampère in some forms of surgical work. We have but to say the word and the electrical engineer stands ready, for a consideration, to give us what we ask. How can we keep ourselves in the advance line but by meeting in such a society as this, investigating the latest instruments, studying their application and how they may best meet our wants.

We need to discuss electro-physics, and give to it more study. I am sorry to see schools of electro-therapeutics with courses of only two weeks. I fear they will only act as boomerangs to the promoters, whereas we could wish them success if only more thorough courses were insisted upon. We all know what a thorough diagnostician was our late-lamented fellow, Dr. Apostoli, from whom I am pleased to have received some of my instruction. His work was thorough in all its details, and we wish that his example could be followed by those making use of electricity.

We do not desire, as members of this society, those who seek to treat hirsuties with an induction-coil or find fault with their voltaic battery because it does not make a noise.

Keep ever in advance. Our terminology needs revision. We should express ourselves so that our electrical friends will understand us, and educate those not with us that faradic and galvanic are terms relegated to the past and join with the physicist and electrical engineer in saying that "alternating" and "continuous" currents should be the terms employed. One of our most urgent needs is a larger membership, which at the same time would give us more working financial capital. Like all other societies, we must look to its business management. This past year we have been too much embarrassed with a low treasury, and it seems to me that we ought to constitute ourselves a committee of the whole to canvass for eligible, active members of good standing who are making a specialty of electro-therapeutics and who would gladly join if they understood the benefits of membership in this society.

Would it not be well to reduce the initiation fee to five dollars, that to be the dues of the new member for his first year?

There is a thoughtlessness among some members in the non-

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payment of dues which means much to the association. It embarrasses the society and prevents it doing many things which would be for our mutual benefit. This association ought to be free and able to pay its own way when we meet in any of our various cities, and not be compelled to beg from a few of its local members, whoever they may be. All of this could easily be done if each member did his full share of work, and we would be in such a flourishing condition that our "waiting list" would be a long one.

I have mentioned some of the needs of our society. The remedy is with each one of us, and I trust, before our next meeting, the cure will be complete.

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REPORT OF THE STANDING COMMITTEE ON ELECTRODES.

A number of electrodes are submitted for inspection. Our president, Dr. Walter H. White, presents three constructed of aluminum, for use with the static machine,—a disk, a multiple point, and a single point,—of which a description is appended.

Several flat body electrodes, brought before the International Electro-Therapeutic Congress in Paris this summer, a bipolar electrode marked in such a manner that the two poles may be readily distinguished and a connecting cord with tips attached, will be described by Mr. R. G. Brown, a member of the committee.

Your chairman presents some of the electrodes used with the static wave-current, constructed of block-tin, and one of tinsel cloth, of which a description is here appended.

Attention having been directed to a lack of uniformity in designating the respective poles of bipolar electrodes, several manufacturers of electro-therapeutic apparatus were corresponded with by your chairman. The substance of their replies is that no fixed rule exists, and that, in many cases, there is no mark to distinguish one pole from another.

A description of the standard connections adopted by the association in 1895, with their dimensions, having been frequently called for, is here given.

The length and diameter of the split tip will depend upon the size and nature of the electrode of which it forms the terminal. For bipolar and similar electrodes, the split tip (or split spring-post), is made of $^{3}/_{16}$-inch, round brass rod, $^{3}/_{4}$ inch in length, not including the shank. A hole is drilled $^{5}/_{8}$ inch deep into the tip, using a standard Morse drill No. 47; the tip is then slit down its length to the bottom of the hole with the ordinary hack saw. The shank is made of a length to suit the case, and is threaded to screw into the electrode, standard threads only being used. When serving as the terminal of a slim electrode, the shank is dispensed with and a hole of suitable size drilled in the solid end of the tip, into which the end of the electrode is soldered.

For connecting cords the split tip is made of $^{1}/_{4}$-inch brass rod 1 inch in length, filed flat on two opposite sides; a hole is drilled,

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through its whole length, with a standard Morse drill, No. 47. The tip is slit down three-fourths of its length and a flaring mouth filed on the split end. Into the other end is soldered a cut-down "ordinary" medical tip, or other special tip, to which the conducting cord is attached. The straight tip (stem-tip, or plug) should have a diameter slightly larger than a standard Morse drill No. 47 (two and one-half thousandths of an inch larger): just large enough to fit snugly into the finished split tip.

All connections should be nickel-plated.

Your committee would recommend:—

1. That the connections as described, having been already recognized as the standard connections of the association, the dimensions given, be accepted as standard measurements.

2. That the following manner of designating the respective poles of bipolar electrodes, where the poles consist of a ring, and a top or bulb,—namely: a mark on the top or bulb, and a corresponding mark on or near the split tip in which that pole terminates, and that connection be by split projecting tips,—be approved by the association.

3. That a suitable circular be prepared by the Executive Council and sent by the secretary to the various manufacturers (principal manufacturers of electro-therapeutic apparatus in America and abroad) and an adequate number of copies be furnished to the members of the committee for use in their correspondence connected with this work.

4. That the contents of this circular be: (*a*) The objects of this association and of its standing committees, with a list of the names and addresses of the members of the various committees.

(*b*) The reports or extracts therefrom, or recommendations of the various committees.

(*c*) Any other suitable information that may be deemed of interest or utility to manufacturers.

5. That this committee's contribution to the circular be a description, with dimensions, of the standard connections approved by the association; style of rheophores; manner of designating the poles of bipolar electrodes; and an invitation to manufacturers to adopt the same with a view of attaining uniformity and thereby avoiding the troublesome alterations now rendered necessary, in

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so many instances, when the instruments of one manufacturer are used with the connections of another.

(Signed) CHARLES R. DICKSON, *Chairman.*
JOHN GERIN.
R. G. BROWN.

New York, September 25, 1900.

APPENDIX TO REPORT ON ELECTRODES.

No. 1. *Aluminum as a Metal for Static Electrodes.*—By Dr. Walter H. White. Having used for some years the usual static electrodes of brass, which are more or less heavy for anyone using them frequently in the manipulation of patients, especially those instruments of metal throughout, where the current is grounded through the operator, and not feeling satisfied with those I had seen made of aluminum, I ordered first this disk, which is a copy of a French electrode, or exciter, as it is called. It is made of aluminum, the disk being $^3/_4$ inch in diameter, with 12 rivets placed in a circle and 4 in the centre, each about $^1/_2$ inch in diameter, with smooth, rounded surfaces. The disk is fastened in the centre by a screw to the handle, which is 13 inches long and $^1/_2$ inch in diameter. This I use in manipulating the spine and back.

The next instrument is the multiple-point electrode, the handle and disk being of the same dimensions as the previously-described electrode. This electrode has thirteen points: seven points near its outer circumference, with six in a circle within. They are all $1\,^1/_2$ inches long. The points are of steel, sharply pointed and driven solidly into the aluminum disk. In this manner the points are held more firmly to the disk, and are not unnecessarily long and not so easily loosened as one I have already seen.

The third instrument is a metal point, $12\,^1/_2$ inches long and $^1/_2$ inch in diameter, with a small steel rod running up inside the aluminum handle about 1 inch and swaged thoroughly, leaving $^1/_2$ inch of steel outside, bringing it to a sharp, needle-like point. Such sharp points, as you know, give a fine spray, without sparks, and, used with a large static machine, give a fine, prickly sensation, with more or less redness of the skin, the effect being similar to a mustard plaster, and very efficacious in some rheumatoid affections. All of these instruments are thoroughly nickel-plated, thus preventing

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the blackening of the hands of the operator, and so overcoming the chief objection, in the frequent handling of aluminum instruments.

(Signed) WALTER H. WHITE.

July, 1900.

No. 2.—Mr. R. G. Brown, of the committee, presented his perforated flat electrode, made in both brass and aluminum. The plug connection was again shown, and its advantages emphasized. He said that it had been found that aluminum is acted upon by salt-water. Mention was made of the use of amidou, or punk. Pads are made of the amidou, covered on both sides with linen, and then carefully quilted. Unless constructed in this way the amidou shrinks considerably when moistened. The connecting cord which he recommended is one made of tinsel and covered with rubber tubing. It was recommended that, as a matter of uniformity, the marked terminal at the rear of the bipolar electrode should always correspond with the distal metallic portion of the instrument. The connections should be made by means of a plug and split tube, and the electrode is preferably constructed so that it can be separated and disinfected.

No. 3. *Electrodes for the Static Wave-current.*—As some of our members may not be familiar with the electrodes which are used in connection with the static wave-current, I present a few employed by myself, and submit convenient dimensions for such, not on account of any novelty in form or construction, but because I am not aware that any static wave-current electrodes have been shown before the association hitherto. Their chief recommendation is that they are of materials readily procurable, and easily cut into desired shapes as occasion may arise. They are as follow:—

A short, narrow electrode with rounded corners 8 inches long by $1\ ^1/_4$ inches wide (m. 0.20 by m. 0.03) for the back of the neck, wrist, etc.

A long narrow electrode 24 inches by $1\ ^1/_4$ inches (m. 0.61 by m. 0.04) for the spine, arm, or leg.

A small oval electrode $4\ ^3/_4$ inches by $2\ ^3/_8$ inches (m. 0.12 by m. 0.06) for the front of the neck or the abdomen.

A large oval electrode 8 inches by 4 inches (m. 0.20 by m. 0.10) for the abdomen, etc.

All of the foregoing are cut out of block-tin $^1/_{16}$ inch thick

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(m. 0.001), which can be procured from dental supply-stores. This material can be very readily cut into any desired shape by a pair of heavy shears, and can be bent, and so made to conform fairly well to most parts of the body. A still more flexible electrode can be constructed out of sheet-tin one-half the thickness of the other; a convenient form for the abdomen or a foot-plate is 9 inches by 5 $^{3}/_{4}$ inches (m. 0.23 by m. 0.145).

Where yet more flexibility is desired,—for instance, when one wishes to have the electrode conform snugly as a bandage about a part,—a material known as "metal cloth" is sometimes employed; as I was unable to obtain this in Toronto, I have been using a variety of "tinsel cloth," known to theatrical outfitters as "cloth of gold," cut in strips about 4 inches wide (m. 0.10). The strip shown is 24 inches long (m. 0.60), that being the width of the material; three such strips will cover the foot and leg half-way to the knee or more.

The connector shown can be used with all of these electrodes; it is a simple spring-clip and was manufactured by the Kidder Company.

Any ordinary conducting cord will suffice, but it is well to slip a piece of rubber tubing over it to increase its insulation; otherwise it is sometimes unpleasant when it touches the patient.

CHARLES R. DICKSON.

Toronto, Canada, September 21, 1900.

NOTE: The metric system having been adopted by the association some time ago, dimensions are given in it as well as in the English system above.

DISCUSSION.

DR. DICKSON moved that the report of this committee be accepted and its recommendations adopted and published. Seconded by Dr. G. B. Massey.

DR. G. BETTON MASSEY, of Philadelphia, congratulated the chairman, and his colleagues on the committee, for their very useful and practical work in the direction of improving the electrodes. He was personally in accord with all portions of the report. In his opinion, the number of points on the static spray electrode was entirely insufficient, for, unless these points were very numerous, the use of this instrument with a powerful machine was apt to result in the passage of a spark. For some time he had obviated this difficulty by making a rosette of the metallic thread used in the manufacture of tinsel cloth. The rosette is made by winding this material around the hand until the whole spool has been used up, and then clipping the thread so as to produce

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a tuft or rosette having a very large number of small points. Benjamin Franklin had shown that the danger of producing a spark was reduced in proportion to the number of points. Another advantage was that the tinsel is soft, and, unlike the stiff, metallic points, would not injure the patient if accidental contact with the electrode occurred. He saw no reason for using punk when absorbent cotton was so easily procured. He would use an electrode made of sufficient absorbent cotton to make a pad about one inch thick when wet. The connecting wire should be sewed to the cotton in the shape of a flat spiral on the back.

DR. R. J. NUNN, of Savannah, said he was opposed to the society committing itself to the use of any particular substance for electrodes, for, as had been said by the last speaker, each practitioner would probably always prefer a certain material. It was well to recommend the use of common and easily obtained material, but this was not the case in regard to substances such as punk. It seemed hardly necessary to go to the south of France for the material for electrodes. A few layers of lint put in a bag, and the cords sewed to the bag, gave a simple, cheap, cleanly, and most easily made electrode. The corners should be sewed so as to smooth out all wrinkles. Such an electrode adheres admirably to the skin. Beyond question tin was a valuable material for electrodes, but it is only useful in connection with currents of high voltage and low ampèrage, as for other currents it oxidizes very rapidly if the electrodes are used moist. The worst feature of this was that the tin oxidizes at a distance from the connections, and consequently the current jumps very unpleasantly. He had at last settled down to the use of annealed, thin, copper electrodes, which possess the advantages of tin without its disadvantages. Aluminum also oxidizes rapidly and becomes brittle, as one could easily learn by wearing a jacket of this material during hot weather. For connecting cords he had used almost entirely the ordinary cord used for electric lighting. One variety of this cord appears in the market covered with asbestos, and the other with a gutta-percha compound. If used in the form of the double cord it will not kink.

DR. W. H. WHITE, of Boston, in defense of his electrodes, said that they were modeled after French electrodes. The modification had been made because of the great weight of the originals. To prevent the blackening of the hands the electrodes were nickel-plated. With regard to the original single-point electrode, the point dropped out because not inserted sufficiently deep into the handle. All of these electrodes were used with the French method of giving static electricity. The "breeze" is made by sweeping the electrode near the patient, producing a prickling sensation, but no sparking. He had used it for five or six years, and had never produced sparking, because the instrument is not brought near enough to the patient. If the points are made of brass instead of steel, they become dull. One of the speakers had mentioned tinsel. There is a form of tinsel cloth, known to the trade as "armor cloth," which is very good. He had used a different kind, having more tinsel in it. With this he had made the electrode in the shape of a mitten. This should be made quite large in order that the operator's hand can be made easily to conform to the different parts of the patient's body in making applications of static electricity.

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DR. MASSEY explained that what he had said about rigid points would not apply to the method used by Dr. White, but only in an all-metal circuit and particularly when the electrode was mounted on a standard.

DR. FRED. H. MORSE, of Melrose, Mass., said that he had tried all of the materials mentioned, and during the past year had been trying asbestos cloth as a covering for moist electrodes. It could easily be obtained in the market, and was very inexpensive. It should be made into pads like those recommended by the Electrode Committee, but the back should be covered with rubber. It could be boiled or baked, and so was applicable on the score of cleanliness. It is the material used by plumbers to wrap around steam pipes.

MR. BROWN, in closing, said that the punk, or amidou, could be bought for one dollar a pound, and a pound is a very large quantity. It was intended that the tin electrode should be used only with the static machine, and hence this did away with the objection of Dr. Nunn, that it oxidizes rapidly with currents of high ampèrage. The chief advantage of the punk was that it held such a large quantity of water. The committee did not recommend these materials especially, but had collected them together for the information of the members.

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SYMPOSIUM ON ELECTRICITY IN TUBERCULOSIS.

ETIOLOGY OF PULMONARY TUBERCULOSIS, ITS COURSE AND TERMINATION.[1]

By S. A. Knopf, M.D., New York.

Mr. President, Fellows of the American Electro-Therapeutic Association, and Invited Guests: My first duty is to thank you for the honor conferred upon me by the invitation to address you this afternoon. The theme of my discourse has not been selected for me, but, of the eight or nine titles of subjects which were submitted to me in writing by your chairman of the Committee on Arrangements to choose from, the one which is the title of this paper was the only one which did not treat of electricity, and that is the reason why I selected it.

Most of you are masters in electro-therapeutics, while your humble servant is only a novice who probably would have done much better had he simply come here to listen and to learn instead of coming to talk, the more so since it will be exceedingly difficult for me to present to you anything new in regard to the etiology, the course, and termination of pulmonary tuberculosis. I have only one hope: that is that the presentation of my theme may call forth such a lively and interesting discussion by the many electro- and phthisio-therapeutists present that the result of your deliberations will be of benefit to all of us as physicians and a blessing to our patients.

The etiology of tuberculosis in man should be divided in two great parts: First, we should study the sources of infection, and, secondly, we should investigate the causes which make it possible for the bacillus of tuberculosis to incite in our system such pathological changes, characterized by the production of the tubercle, the breaking down of the affected tissue, and the accompanying phenomena due to the toxin, or poisonous secretions of the micro-organisms.

The most frequent source of infection is, perhaps, after all, the one from man to man. Tuberculous sputum, deposited carelessly on the floors of our private and public buildings, is allowed to dry

[1] Opening address for a Symposium on Tuberculosis delivered by invitation before the American Electro-Therapeutic Association, at its Tenth Annual Meeting in the city of New York, September 25, 1900.

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and pulverize, and thus the air breathed in these localities is often laden with bacilli. We know that a consumptive may expectorate as many as seven billions of bacilli a day; but this great number of dangerous micro-organisms may not only be eliminated by the consumptive in the last stages of the disease, confined to his bed, but also by the tuberculous individual up and about, perhaps even attending to his vocation. The remedy for this evil, which is as well known to you as to me, lies in the education and the conscientiousness of the tuberculous invalid. If he is careful and never expectorates except in a proper receptacle, one of the main sources of communicating the disease to his fellow-men will be done away with.

Fig. 1.—Dr. Knopf's Aluminum Pocket-flask.

Whether the patient uses a pocket-flask (Figs. 1 and 2), such as you see here; a sanitary spit-cup (Fig. 3); or one of Seabury & Johnson's spitting-boxes (Fig. 4); Japanese handkerchiefs, or simply pieces of muslin, matters little as long as he does not expectorate in any place where the infectious sputum may dry, pulverize, and be inhaled with the dust of the atmosphere.

Drop-infection—that is to say, the expulsion of particles of saliva containing the bacilli, during cough without expectoration or while talking or sneezing—does certainly exist. Experiments, however, have demonstrated that, for the infection to take place through the expulsion of particles of sputum, a close proximity to the invalid

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is essential, for these particles could not reach a person three or four feet from the patient. Again, this danger is still more reduced by the fact that not all individuals, afflicted with pulmonary tuber-

Fig. 1*a*.—Funnel to Dr. Knopf's Aluminum Pocket-flask.

Fig. 2.—Dr. Knopf's Pocket-flask for Tuberculous Patients, made of White Metal.

culosis, have bacilli in their saliva; also the time the physician, nurse, or friend need be in close proximity to the patient is rarely longer than a few moments.

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Next or equal in frequency is the method of infection caused by ingestion of the bacilli with food, such as meat, milk, or butter. The duty of the State or municipal government is to protect its

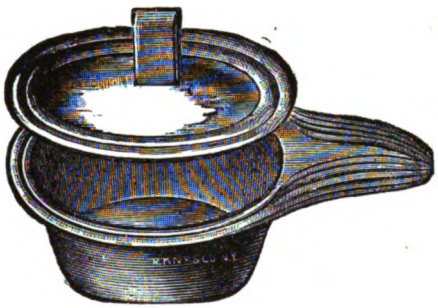

Fig. 3.—Kny-Scheerer Sanitary Spit-cup of Pressed Paper.

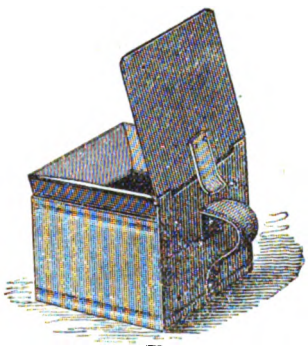

Fig. 4.—Seabury & Johnson's Spitting-box Frame.

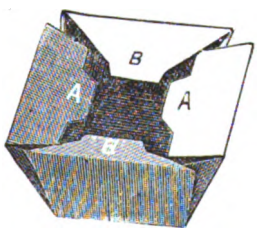

Fig. 4*a*.—Folded Pasteboard Ready for Frame.

citizens by good bovine laws from this source of infection as far as it is possible. It is not within the scope of this paper to speak in detail on the combat of tuberculosis in the bovine race; all I may

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be privileged to say is that, without the federal government at the head and an harmonious working of all States and municipalities, it will be impossible effectually to diminish bovine tuberculosis as a source of infection in the human race. Do not blame one State for becoming discouraged in expending thousands of dollars every year for the purpose of diminishing tuberculosis among cows when in the neighboring State nothing at all is done, except that individuals who have an eye for business resort to the following practice: Knowing that the neighboring State with good bovine laws will not allow any animals afflicted with the disease within its borders, they drive all the sick and emaciated cattle into that State under cover of darkness. An obliging farmer boards them for a good commission, and at the next visit of the sanitary inspector they are tested, found tuberculous, and killed, the owner receiving a good compensation for his well-nigh worthless animals.

Only through federal laws and regulations can such evils be remedied. You all will agree with me when I say that the time for the establishment of a federal department of health in Washington, with a competent secretary, preferably a trained sanitarian and physician, at the head, is not only ripe, but is an urgent necessity, since our national welfare, in no small measure, depends upon the creation of such an institution. Nearly all civilized countries have a ministry of public health; surely the United States, the greatest and most progressive republic in the world, and of which we all are so justly proud, should not be behind any country in the world in this respect. Think of the advantage of having a national board of health, being in constant communication with the officials of every State, city, or county board of health in the Union! Disasters, such as befell our sister-state Texas recently, the outbreak of epidemics, and even that of the greatest of all plagues—human tuberculosis—could certainly be more effectually dealt with than heretofore.

Individuals can only protect themselves against the ingestion of tuberculous food-substances by cooking thoroughly all meat coming from doubtful sources, and by boiling or sterilizing the milk derived from cows not known to be regularly examined and tested.

Through kissing tuberculous individuals tubercle bacilli may enter the digestive tract, and an infection may thus take place. Autoinfection by ingestion of the expectoration is frequent in the insane suffering from consumption, and this may even happen in sane tuberculous patients, who, out of false modesty or habit, swal-

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low their tuberculous sputum. Ingestion must also be considered possible through infected hands, and patients and nurses should always be enjoined to wash their hands carefully before touching food. Bacilli have been found in cigars made by hand. This may be accounted for by the fact that the outer leaf of the cigar is moistened with saliva, and if, as is not infrequent, the cigar-maker happens to be tuberculous, the bacilli may thus be conveyed to the smoker. The main remedy for this must lie in the sanitary supervision of cigar-factories; no tuberculous individual should be employed there, for he may not only transmit his disease in the mode just described, but by the close proximity in which cigar-makers labor he may convey this disease to his fellow-workmen. The same precaution should be exercised in printing-offices, tailoring-shops, etc. Also, no patients suffering from pulmonary or laryngeal tuberculosis should ever be employed in occupations which demand the handling of food-substances.

The third source of infection is by inoculation, to which, perhaps, are most frequently exposed the nurses and friends who clean the vessels in which tuberculous patients have expectorated. The replacing of all porcelain vessels by metal cuspidors, and the injunction to wear rubber gloves during the process of cleaning these vessels, will lessen the alas! very frequent accidents of local inoculation of tuberculosis.

Medical students, dissecting bodies of individuals having died of tuberculosis, and pathologists handling tuberculous specimens or performing autopsies, should exercise extreme care; so should surgeons and nurses treating tuberculous surgical affections.

Veterinarians, too, should be exceedingly careful to avoid inoculation, not only when performing autopsies, but also when testing cattle for tuberculosis. The recent death of a talented American veterinarian through the accidental inoculation of tuberculin is still fresh in our minds.

The ritual act of circumcision practiced according to the orthodox Jewish belief has, in numerous instances, been the occasion of transmitting to a healthy child the disease in question. Cases have been reported by Lindemann,[1] Jacobi,[2] and others. The operation

[1] Lindemann, *Deutsche medicinische Wochenschrift*, No. 30, 1883.

[2] Jacobi, in Knopf's "Pulmonary Tuberculosis, its Modern Prophylaxis and the Treatment in Special Institutions and at Home." P. Blakiston's Son, Philadelphia, 1899.

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of circumcision, when skillfully and rapidly performed, is in itself trifling, but the sucking of the prepuce afterward makes it dangerous. This latter portion of the procedure should be either prohibited or done by the aid of a glass tube, as practiced in France and Germany.

In short, whenever a tuberculous secretion or substance enters an open wound, inoculation is possible. Thus, tattooing or the simple procedure of piercing the ear-lobe has given rise to local tuberculosis, owing to the ignorance or carelessness of the operator when the latter happened to be consumptive.

In speaking of infection by inoculation we must mention yet autoinoculation of the patients themselves. So, for example, it has happened that a consumptive, injuring his finger, put it in his mouth, the bacilliferous saliva entered the wound, and the result was a local tuberculosis.

After having rapidly reviewed the main causes of infection we will now briefly study the causes which make it possible, after the entrance of the bacilli into the system, to render the individual tuberculous. Normally, the accidental inhalation of air laden with dust and bacilli does not render the healthy individual tuberculous; neither does the occasional ingestion of a few bacilli with our food or milk. The ciliated epithelial lining of the upper respiratory tract is a physical hindrance to the entrance of bacilli. The nasal mucus in health is bactericidal, and the act of sneezing, when caused by the inhalation of dust-particles, I have no doubt is also an effective physical means of getting rid of any micro-organisms lodged in the nasal cavities. The gastric secretions are, in a measure, also bactericidal, and, in combination with the phagocytic power of the blood in its normal condition, we have enough means of defense to throw off any number of pathogenic microbes. But anything diminishing the physiological powers just enumerated must be considered an indirect etiological factor in the production of tuberculosis.

I use the words "physiological poverty," which seems to me to best convey the idea of a condition enabling pathogenic micro-organisms, particularly the bacilli of tuberculosis, to invade our system. This physiological poverty, or predisposition to disease, may be inherited or acquired.

An hereditary predisposition to consumption is, alas! not always recognized as early as would be desirable in view of the value of

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timely and persistent treatment. I have described this condition in previous writings, but it may not be amiss to repeat it in connection with our present subject. If the predisposed be a child, he will be either undersized or present an almost abnormal height for his age, with a narrow chest. He will be a bad eater, irritable, nervous, anæmic, with irregular digestive functions, at times constipated, at times suffering from diarrhœa, prone to all the diseases of childhood, and still mentally rarely behind his more robust companions. He is averse to out-door play, and, owing to his delicate constitution, he is allowed to have his way, and his character is often spoiled.

The adult candidate for pulmonary tuberculosis differs from his younger brother but little; the *physique* is the same; the peculiar condition of mind is more pronounced; while sanguine at times, anxieties, disappointments, especially unfortunate love-affairs and similar sorrows, often suffice to bring about a rapid development of the disease. In sorrow one eats but little; the arterial pressure is low; the muscular weakness and depressed nervous state makes the act of breathing incomplete.

A disposition to tuberculosis may be acquired, first, by privation of sufficient and nutritious food, air, and light; second, by phthisiogenetic diseases, such as pneumonia, pleurisy *a frigore*, severe grip, variola, scarlatina, typhoid fever, and other eruptive diseases; third, by extreme worry and mental anxieties; fourth, by grave traumatism or severe shock; fifth, by syphilis and severe gonorrhœas; and last, but not least, by alcoholism and excesses of other kinds.

Whether the predisposition is acquired from one of these causes or is hereditary, the treatment must be the same: that is to say, preventive and curative. I shall not speak of therapeutics in particular; but, speaking in general, I may be permitted to state that my faith lies in the prophylactic, dietetic, and symptomatic treatment, under the best possible hygienic conditions in a special institution or at home, but always under constant medical supervision.

The course and termination of the disease of which I am to speak as well depends upon a multitude of conditions. Do not consider me a utilitarian if I say that much depends upon the money-bag of the invalid. If a patient is poor, as individual physicians I know everyone of us would be willing to treat him gratuitously and even supply him with the necessary medicines; but what he needs most—plenty of fresh air, the best of food, good hygienic environ-

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ments, no care and anxieties—is difficult for us to provide for him. Yet you know that without it our skill and our medicines will do him no good, and the course of his disease will be interwoven with untold sufferings and privations. I do not know of a sadder fate than that of a consumptive without means and probably a wife and children depending upon him for support.

That the establishment of a number of institutions for the care of the consumptive poor will alone be able to lessen these sufferings and reduce the centres of infection created by the consumptives living in the tenement-homes must be evident to everybody.

Tuberculosis is eminently a curable disease. The tubercle, instead of being a miserable neoplasm, incapable of organization, has a natural tendency to fibrous formation. Thus, the course of the disease will be favorable as long as we can create, by an abundance of good air and good food, enough new fibrous connective tissue, and increase the phagocytic power of the blood and the various secretions. As long as the stomach holds out, there is hope for the patient. To make it hold out long, to make it do good work, to help assimilation, is the task of modern phthisiotherapy, and upon its success depends the course of the disease.

At times, the course of pulmonary tuberculosis is associated with a good deal of suffering, not only of body, but also of mind. For the physical suffering judicious symptomatic treatment, in the hands of a skillful physician, will give the patient much relief. To treat the psychical phenomena, so peculiar to many consumptives, amounting with some to intense mental suffering, will require all the forbearance, tact, and firmness of the cultured and devoted physician. The course of the disease in the cheerful and obedient patient is likely to be more hopeful than in the morose and disobedient invalid. Whether the patient has contracted tuberculosis because of an acquired or hereditary disposition, I think, makes little difference in the course or prognosis of the disease. The prognosis of pulmonary tuberculosis depends as much upon the individual as upon the disease itself.

The termination of pulmonary tuberculosis is unique and differs from any other disease. If fatal, death may be the result of an extreme emaciation and a gradual failing. At times, a severe hæmorrhage causes a relatively sudden death; so may asphyxiation, due to the diminished respiratory area. But I believe that in the majority of cases, when a tuberculous patient dies, it is the result

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of the association of other pathogenic micro-organisms with the bacillus of tuberculosis, or, in other words, a mixed infection: an intense toxæmia. The termination for which we all hope and labor is, of course, cure: re-establishment to health.

As to the degrees of cure, opinions differ widely. Some authors speak of an absolute cure and of a relative cure; some of arrested cases and improved cases; some do not at all believe in the possibility of cure in the *ad integrum* sense. Myself I am optimistic enough to firmly believe in the absolute curability of pulmonary tuberculosis. As to the prevention of tuberculosis, I go still further in my optimism, for I think, with the immortal Pasteur, "It is in the power of man to cause all parasitic diseases to disappear from the world," and tuberculosis is a parasitic disease *par excellence.*

Even with our present knowledge of the etiology of pulmonary tuberculosis, limited as it is, I believe the time is not far distant when the prevention of tuberculosis will be a popular science, understood by everybody. When our statesmen and city fathers will realize that by providing comfortable and sanitary homes for the poor, plenty of public parks, gardens, and playgrounds, they will not only diminish the frequency of tuberculosis, but improve the sanitary and moral conditions of the laboring classes in general, and a large step toward the prevention of tuberculosis will have been accomplished. When our philanthropists, anxious to help their suffering fellow-men, will give us all the money needed to treat the consumptive poor in sanatoria and special hospitals, we may be able to modify for the better the course and termination of the disease in the majority of sufferers, who are the poor.

From time immemorial physicians as a class have labored to become masters of this disease. There is now hardly ever an important session of medical men where the difficult problem of tuberculosis is not discussed. It does the American Electro-Therapeutic Association great honor to have a symposium on tuberculosis placed on its program of this year's session. With all my heart I wish that the wisdom and experience of its members in the therapeutic application of electricity may help us to better the course and termination of this terrible disease.

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THE MODERN TREATMENT OF PULMONARY TUBERCULOSIS.

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Upon the threshold of the twentieth century there dawns a new era in practical therapeutics. No less a boon than the successful treatment of the greatest scourge to which human flesh is heir.

A short while, a bit more patience, and a trifle more effort are still requisite for its consummation and general acceptation. A short time is still required before this knowledge will be appreciated by the great body of general practitioners.

The present is formative. It is a transitional period. The profession, in general, has scarcely as yet emerged from the gloom of empiricism, in the treatment of this disease, through which it has been groping from time immemorial.

No single period in the world's history has been so fraught with practical progress in phthisio-therapeutics as the closing years of the present century. Perhaps no similar period has possessed so many ardent workers in this field, nor has greater amount of effort been expended.

The studies and perquisitions of Cornet, Strauss, Chauveau, Cohnheim, Villemin, Klebs, Aufrecht, Koch, and others have served to elucidate and exemplify its etiology and pathology. We are indebted to these gentlemen for a clear and accurate conception of the causes and factors involved, without which there could be no rational treatment.

A brief reiteration of certain etiological and pathological principles is essential to a proper comprehension and lucid understanding of the modern methods of successful treatment.

Tuberculosis is a disease of crowding[1]; of unsanitary dwelling[2]; of deficient ventilation[3]; of insufficient use of soap[4] and water[5]; of deficient and insufficient feeding[6]; of uncleanliness[7]; of defective hygienic environment[8]; in short, of departure from the conditions of a healthy animal life.[9]

True, it has a specific infectious organism; but the bacillus is only the "histological exponent, not the whole of the tubercle, much less of the disease."[10]

Local tuberculosis, regardless of its situation in the human

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economy, has the same characteristics: the *locus minoris resistentiæ* and the proliferation of connective-tissue cells resulting in a sequestration of its offending concomitant infective agent.

Remove the primordial etiological factors enumerated, and the disease abates. Neglected, further infection ensues. That is the so-called mixed infection. The ubiquitous pyogenic organisms find a suitable soil, and then is presented the typical clinical configuration of consumption.

Pure local tuberculosis, whether pulmonary or articular, does not possess the time-honored and respected signs of inflammation: *rubor, dolor, tumor, calor, et functio læsa.* Pulmonary tuberculosis is quite afebrile and without exudation, but plus mixed infection and pulmonary phthisis is the sequence. In other words, phthisis is pulmonary tuberculosis plus a pyæmia or septicæmia. The due appreciation of this complication is of paramount importance, for almost all the dreaded symptoms of phthisis are the result of this pyogenic superinfection.

The subject of mixed infection has recently been studied with great care by one of the cleverest of bacteriologists, Sata, of Tokio, Japan. He has shown that the broncho-pneumonia of consumptives is due invariably to these mixed bacteria. The predominant micro-organisms are the streptococcus pyogenes, staphylococcus pyogenes, diplococcus of Fraenkel, and Pfeiffer's influenza bacillus.

Sata,[11] Pfeiffer,[12] and Brieger,[13] in harmony with Petruschky, attribute the hectic fever and night-sweats to the work of the streptococcus. These gentlemen have been able to recognize the so-called streptococcic curve in the fever-charts of many consumptives. Further, the staphylococcus pyogenes, from its known liquefying action upon connective tissue, is, in the main, responsible for the breaking down of pulmonary tissue. Pfeiffer's bacillus, as well as Fraenkel's, often causes a consolidation, thus hastening the progress of the disease. The bacillus pyocyaneus of Gessard gives the characteristic greenish coloring to the sputa. The micrococcus tetragenus described by Koch and Gaffky is frequently found in phthisical sputa, as well as many other micro-organisms having more or less pathogenic qualities.

Now, as for treatment. It is obvious, to again quote Brieger,[14] that a specific serum cannot meet the indications furnished by a mixed infection. It has been repeatedly noted that, in the contest between the system and the organisms associated with phthisis, the

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leucocytes and their alexins play a lesser part than in any other infectious disease.[15]

Yet there are many who still have faith, for instance, in Koch's tuberculin in spite of Virchow's protestations, or Hausemann's and Baumgarten's assurance that an eruption of tubercles occurred regularly during the injections; or Bozzolo's[16] observation that it converted a chronic process into an acute; or Papillon's[17] evidence that the reaction was to be obtained in any ordinary cachexia; or Landouzy's[18] in general erethism.

There are yet advocates of Maragliano's serum, notwithstanding de Renzi's[19] and Fraenkel's[20] demonstrations as to its futility; of Klebs's and Hutinel's, in spite of Debove's,[21] Blache's,[22] and my own[23] investigations. Portucalis's[24] recent advocation of a serum prepared from tertiary syphilitics, which he considers "would be of great advantage to consumptives," should surely require no contradiction. It is manifestly absurd.

But it is hardly necessary to mention each and every one. Omeltchenko[25] has experimented with a variety of sera, and found them wanting. The consensus of opinion, it seems, is with Beck,[26] Rabinowitsch,[27] Osler,[28] Richardière,[29] Sir Herbert Maxwell,[30] Pye-Smith,[31] and others, that all sera, diagnostic or specific, have proved nugatory in their application to this disease.

As for drugs. Centuries of experimentation with every ingredient mentioned in the pharmacopœia have given us not a single one that has the slightest favorable action upon tuberculous processes.[32] Even the much-vaunted creasotes, guaiacols, and the like have proved in some instances inert,[33] in others injurious.[34] However, be they inert or injurious, they have certainly, to use the words of Osler, "no essential influence on the progress of this disease."[35]

Again, the virtues of *climate, altitude, and atmospheric pressure*, upon which so much reliance has been placed, have dwindled beneath the search-light of close investigation. The old theory of immune zones is no longer tenable. The bacillus is found regardless of temperature, of elevation, of moisture, or of prevailing winds.[36] The disease prevails regardless of demographical conditions or geographical positions.[37]

Thus, we find Crowley[38] and Duckman,[39] of California, inveighing the practice of sending the tuberculous to their State; the Honolulu health reports,[40] showing progressive increase in tuberculosis among the natives; Girdner[41] affirming the percentage among

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the citizens of Asheville, N. C., the same as that of Manhattan; Newton[42] assuring us of its prevalence among the natives in the Adirondacks; Davies[43] demonstrating tuberculosis rampant even upon the Isle of Man, "where the temperature is equable, sunshine abundant, and fogs unknown." Yet the climate of these places has frequently been lauded as a specific in consumption.

Detweiler[44] and Blumenfeld, it is affirmed, were the first to prove these factors unessential to treatment. Lannelongue, Achard, and Guillard[45] have recently carefully studied the question of the influence of climate upon the evolution of tuberculosis. Their conclusions are as follow: "In certain regions the disease is rare, and its relative infrequency is attributable solely to the mode of life of the inhabitants. The improvement which has been noted in patients at health resorts which have a reputation for the cure of phthisis is due alone to the effects of the different methods of treatment adopted, and cannot be attributed to the region or place." F. Hueppe's[46] deductions were practically the same.

That climate is unessential to successful treatment was the verdict of the International Medical Congress, held at Moscow in 1897.

Dr. Pannwitz's report as general secretary of the Berlin Congress of Tuberculosis contains the following: "The fact has been proved that tuberculosis can be treated successfully anywhere without regard to climate."

"Elevation," to quote Braine-Hartwell Birmingham,[47] "of a few hundred feet may be desirable, though not necessary." J. E. Birmingham[48] declares from much experience that "elevation has no influence whatever over this disease. Patients do as well at sea-level as at high altitudes."

Atmospheric conditions are unimportant. Barometric pressure does not hold the slightest causative relationship to any disease.[49] Professor Stewart, in his address before the International Congress, showed that the results obtained in Edinburgh, with its "rain and mist and east winds," were equal to the most favorable obtained in Germany.

If further evidence along this line be desired, we refer to Walker,[50] Burton-Fanning,[51] von Schrotter,[52] Otis, Knight,[53] Shaper,[54] Girdner,[55] Tew,[56] Roane Brunnon,[57] Hillier,[58] Wolff, and others.

If drugs, sera, climate, altitude, and atmospheric pressure have proved inefficient, in what does the cure consist?

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The sum-substance of successful treatment resolves itself into the rational application, conversely, of its fundamental causative factors: The diametric antithesis of its so-called predisposing etiology, plus, to use the words of Moeller,[59] "the summation of many minor curative measures, each of which, perhaps, if taken by itself, has but slight effect, but collectively productive of the greatest good."

It is apparent that these measures, with their multitudinous details incident thereto, can properly be carried out only in institutions, where the patients are under constant, competent, sincere, painstaking medical supervision.[60]

To quote a recent author, "The value of sanatoria treatment has been too incontrovertibly demonstrated to permit of any difference of opinion."[61] To mention the advocates of sanatorial treatment for this disease would be but to name every student of the subject the world over, *nemine contradicente*.

Now, as to the armamentaria of sanatoria. Perfect sanitation and prophylaxis, scrupulous cleanliness, the routine of occupation, the systematic hygienic regimen, aërotherapy (*Dauerluftkur*, the time air-cure of the Germans), efficient nursing, and the like, it goes without saying, are of prime importance. There are other measures, however, not generally appreciated, although none the less valuable, which are deserving of consideration.

Foremost among them inhalation, which dates from the period of Paracelsus. "There can be no questioning the fact," to use the words of Schroeder,[62] "that inhalation therapeutics play a great rôle in the treatment of phthisis." Dr. Penrose,[63] of Johns Hopkins, assures us that the antiseptic action of inhalation is manifested by the rapid disappearance of pus-organisms from the sputum, and Burghart[64] and Brieger[65] are practically of the same opinion.

Antiseptics and the aliphatic hydrocarbons of the turpentine group are the ingredients generally used. They are administered by siphon or comminuter arrangement with compressed air. Of course, no sanatorium is complete without its inhalation-chamber, as von Schrotter, Meissen, J. Lazarus, and others affirm; but from special study I am quite satisfied that an equally-valuable method of application consists in charging the atmosphere of the entire institution with antiseptics by means of vacuum-pumps and engine.

An antiseptic or medicated atmosphere constantly maintained, particularly during the night's rest, is certainly, to say the least, an

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efficient coadjutor of the inhalation-chamber. It destroys much of the mixed infection, limits toxin necrosis, loosens and facilitates the removal of alveolar and tubular exudations, and allays local tissue-irritation. P. Lacroix[66] claims still further from his experiments with medicated air that the tubercle bacilli as well as the microbes of mixed infection are destroyed. Properly administered, then, inhalation is, without doubt, the most potent single remedy at our command in the treatment of this disease.

Hydrotherapy is manifestly an essential to successful treatment. It should, however, be systematically and rationally carried out as part and parcel of daily routine. So important is this measure that many enthusiasts, such as Kuthy[67] and Winternitz[68] maintain that cures may be effected by this means alone.

The carbonated or Nauheim bath has been found valuable in its application to this disease; of course, minus the resistant gymnastics. It is a certain means of steadying an intermittent or irregular pulse, or reducing its frequency. By promoting a superficial capillary congestion it likewise tends to relieve visceral engorgement. It is, without doubt, a superior substitute for the pneumatic cabinet.

The importance of diet in a synthetic condition is self-evident. Wilcox[69] and, more recently, Harris[70] have carefully studied the subject; but it is a wide field and worthy of further investigation. Suffice it to say that feeding should be slightly in excess, but the food should be well selected, nutritious, temptingly served, and, of course, properly cooked.

Symptomatic treatment is strictly a subsidiary measure. Schroeder[71] observes that, despite the innumerable substances which have been uselessly employed in connection with the therapy of phthisis, there are certain indications which we are justified in meeting with symptomatic remedies, as drugs and nutrient preparations, as, for instance, hyperpyrexia, hæmoptysis, insomnia, profuse night-sweats; the pains accompanying pleural, laryngeal, or intestinal infection; severe rigors, paroxysms of coughing, diarrhœa, collapse, and the like. At the same time it should not be forgotten that the tuberculous are as prone to the minor ailments as the non-tuberculous, and their innumerable complications or personal idiosyncrasies must necessarily be intelligently dealt with.

Exercise, which many of the earlier phthisiologists, notably Detweiler, deemed appropriate to treatment and encouraged, has

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of late been very much restricted. Dr. Edson,[72] a short time ago, struck the keynote when he said that "there were indications in the pathology of this disease for rest. While physicians followed them as applied to articular and laryngeal tuberculosis, they ignored them when the lungs were in question." Prof. William H. Thompson, at a recent New York medical meeting, averred that even at rest "the constant movement in respiration was a great hindrance to cure."

The advocation of golf and horseback-riding in the treatment of phthisis *a priori* contravenes both pathological and clinical indications. In the light of present knowledge and experience *Liegekur*, therefore, supersedes *Uebungkur*. As Hillier[73] states, frequent and complete rest is imperative.

Last, it is hardly necessary to add that the secret of institutional success lies in the competency and sincerity of the physician in charge, "in his ability," as Muthu[74] puts it, "to discriminate and shape his treatment according to the physical requirements of the individual case."

In conclusion permit me to add that the success of treatment is intimately connected with its early recognition. That pulmonary tuberculosis is positively curable. That it may be diagnosticated even without bacteriological examination, Fraenkel,[75] Fluegge,[76] Petruschky,[77] Anders,[78] Senator,[79] Bozzolo,[80] Giovanni,[81] and many others aver.

As to phthisis, however, it is, of course, dependent upon the extent of lung-involvement and duration. The corollary is patent that treatment must be effected early.

Sanatorial treatment for pulmonary tuberculosis is the achievement of the closing years of the century, and embraces in sum and substance modern and successful methods.

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ELECTRIC LIGHT IN TUBERCULOSIS.

By Charles O. Files, M.D., Portland, Me.

It is unnecessary to dilate upon the prevalence or mortality of tuberculosis. The exciting cause is admitted to be the bacillus tuberculosis. Heredity has ceased to be considered a prominent, direct factor in its causation. Undoubtedly heredity may be blamed for very many weak bodies which easily become the prey of the tubercle bacillus. Sufficient prominence has not been given to the predisposing causes of phthisis. All people in places where tuberculosis is common are exposed to the tubercle bacillus. Some acquire the disease, others do not. The air, water, milk, and meat are more or less full of bacilli. How can *anyone* escape infection? Fortunately, Nature has provided that healthy tissues, oxygen, and light are incompatible with the presence of living, active, destructive bacteria. In order to have healthy tissues, tissues that will successfully resist the attempted encroachments of the tubercle bacillus, it is necessary to have good appetite, good digestion, good food, and sufficient assimilation; in addition, there must be good circulation of the blood,—a normal heart, acting normally,—and a sufficient supply of oxygen. These conditions cannot exist unless there is a suitable—not excessive—activity of body and brain. Any considerable departure from these requirements means impairment of function: lessening of the power to resist disease. Passing over the inherited, the acute, and infectious diseases, and surgical cases, we still have left the great mass of sick people whose illness depends on excessive, improper, or deficient food; a scanty supply of oxygen; and too little or too much exercise of mind or body. It is from these classes the ranks of the tuberculous are recruited. We have hoped to restore them to health by giving codliver-oil, whisky, and hypophosphites as long as we believed the disease was hereditary. When we found the tubercle bacillus we tried to kill the germ of the disease without killing the patient. The result so far has not been brilliant. The bacillus still flourishes, and the disease still slays its thousands and tens of thousands. We have learned that, as a rule, medicines do not cure diseases. Especially in tuberculosis we have learned that good food, good air, plenty of oxygen, and plenty of light are the germicides on which we must depend in making our fight. It has been pretty fairly demonstrated that medicinal germicides do not cure the disease. It is a recognized fact that bacteria

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cannot live when freely exposed to light and oxygen. The question now before us is whether we can cure tuberculosis by an exposure of the patient to the electric light. We can have the electric-light bath either with or without the presence of ozone, which is an allotropic form of oxygen. The action of ozone as an adjuvant of the light is certainly a very great addition to the therapeutic value of the light. The best results are undoubtedly obtained by a cabinet having arc lights in uninclosed globes, supplemented by a large number of incandescent lamps. My own cabinet, built on the plan suggested to me by Dr. Margaret A. Cleaves, of New York City, is simply an arc-light bath. This has not been used by me in a sufficient number of cases to be of value in a scientific point of view. The explanation of the results of this arc-light bath may be one or both of the following facts: Following the analogy of the x-ray, sunlight, and, even more, the arc light may have more penetrating power than we have hitherto realized. The light itself may penetrate deeply enough to be of use as a direct germicide. Again, the light destroys the bacteria in the air which the patient is inhaling to such a degree that the air becomes medicinal or healing, as well as germicidal. In tuberculous affections the general results of any method of treatment on the physical well-being of the patient are of the utmost importance. If we find our patient gaining flesh, with an increased appetite, and better digestion, and with a decrease of cough, while the sputa present a decided diminution of the tubercle bacillus, we expect a recovery. The result of my experience has been that, in every case of tuberculosis that I have treated by the electric bath, there has been improvement in these conditions. I have not had any case under treatment where the patient was in the third, or far advanced in the second, stage of the disease.

With this brief and—to me—wholly unsatisfactory statement of the case, I must throw the whole subject where it belongs, viz.: on the shoulders of those who have had greater experience and larger opportunities than have fallen to me.

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ELECTRIC LIGHT: ITS PHYSIOLOGICAL ACTION AND THERAPEUTIC VALUE IN TUBERCULOSIS OF THE THROAT AND LUNGS.

By W. Freudenthal, M.D., New York.

While in modern times we have quite a number of newly-discovered drugs, some of which exert a remarkable effect on the human system, we have come to believe that bottles of medicine cannot cure every disease nor afford relief to many sufferings with which the physician is daily brought in contact. Thus we have come to rely upon resources which Nature has placed at our command: the scientific application of water, hydrotherapy; the use of light and air, which is still an undeveloped science; and finally the use of electricity in its various branches. The latest of these is the action of the chemical rays of light upon the diseased human system.

We know that already in the olden times, in Greece as well as in Rome, as protection against disease nothing was esteemed so highly as the sojourn in the open air. The sun and the air were considered of the greatest importance for the health and life of man and animal. The whole life of the ancients, as Julian Marcuse[1] rightly says, was built upon this basis, and public affairs, as well as athletic sports, brought the Grecians and Romans on the street and in the open air.

Light and air, the imponderable requisites of unimpaired physical and mental health, were then the foundation of the physical and psychical well-being, which will always remain the characteristic sign of the classical ages. Not only were the bedrooms in old Greece open to the rays of light, but they had, as is well known, on their roofs what was called ἡλιαδτήριογ: a place where they exposed their naked and anointed bodies to the sun, not only for pleasure, but for the preservation of their health as well.

In Rome this place on the roof, which was perfectly flat, was called *solarium*. Afterward this *solarium* was a special annex to the house. The white color of the skin of a man not browned by the sun was considered effeminate, and its possessor ridiculed.

That later on these prophylactic sun-baths were taken to *cure* disease is not remarkable; and in Rome there was hardly a bath-house without a *solarium*; that is, a place to take sun-baths.

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[1] *Zeitschrift für Diät. und Physikal. Ther.*, 1899, p. 336.

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In the middle ages these baths were neglected more and more, until up to the nineteenth century they were entirely forgotten.

It was a layman, Arnold Rikli, of Veldes, in Austria, who not long ago started the first institution for what he termed "atmospheric cure." He deserves great credit for his enthusiasm and energy. Afterward Dr. Lahmann, of "Weisser Hirsch," near Dresden, started a similar institution. It would seem that the success of this "cure" should no longer be disregarded by physicians, and it has become our duty to investigate more closely its merits. I have deemed it important to refer to this, as I consider this therapeutic agent the forerunner of our modern phototherapy, or, more concisely speaking, of the treatment with the electric rays. Sunlight and electric light have the same effect on our system, and it has been proved by thousands of cases already treated that the beneficial result of the treatment with electric light is due to those rays which approximate most closely to the sunlight, namely: the blue and ultraviolet rays of the arc light.

Now, before entering into a discussion on the therapeutic value of the electric light, we have to answer the question, what are the physiological effects of light on the human organism, and especially upon its metabolism?

Very important investigations have been made in this direction as early as 1855 by Moleschott.[1] This author reached the following results: Frogs give off one-twelfth to one-fourth more CO_2 in the light than in the dark: *i.e.*, the temperature being equal or nearly so, and the units of body-weight and time being the same. Further, the greater the intensity of the light, the greater the quantity of CO_2 given off, which is reduced to a minimum on foggy days.

Von Platen made experiments on rabbits, covering their eyes alternately with black or with transparent glasses. He proved that under the influence of the light the gaseous and watery exchanges were considerably increased. The oxygen-consumption in the light and darkness was as 116 to 100; the elimination of CO_2 as 114 to 100. Later on Moleschott and Fubini demonstrated the fact that this influence upon the metabolism is present even after the eyes have been enucleated: that is, it takes place also by means of the skin.

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[1] *Wiener medicinische Wochenschrift*, No. 43, 1855, and Pflüger's *Archiv für Physiologie*, B. 11, p. 272.

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After the preliminary experiment of Reid, Scharling, and Marchand, it was proved by Pettenkofer and Voit that man gives off less CO_2 at night during sleep than in the day-time, at absolute repose. They proved, therefore, that light is here of importance.

I omit all the mass of other researches regarding this particular question. Everyone interested in it will find the literature in a work by Willibald Gebhardt,[1] entitled "The Healing Power of Light," which every physician ought to read. I also refer to a dissertation by Franz Schoenenberger,[2] where a great deal of the literature can be found.

Having confined my investigation to diseases of the respiratory tract, it became necessary, in order to understand the finer mechanism of the rays of light, to study their effect upon the mucous membrane of this tract, and especially upon that of the bronchi, etc. In this respect the investigation of Dr. S. Bergel, of Inowrazlaw, are of very great importance to us. Dr. Bergel,[3] whom I personally have the pleasure of knowing for a good many years, studied entirely independently of the subject under discussion, some eight years ago, the effect of light and dark upon the movement of the ciliary corpuscles. He says that the peculiar behavior of the ciliary corpuscles toward light and darkness was of especial interest. He proceeded in the following manner: He put the microscope into a dark cabinet, which was placed upon the observation-table. The cabinet was perfectly closed, with the exception of two openings. The one, when illuminated, was for the observer; but could be darkened by means of curtains, when it was desired to shut the light off. Just opposite the microscope was another opening, which could be exposed to direct sunlight or closed, as desired.

Now, if a ciliary corpuscle in motion was placed under the microscope, and the latter darkened, it could be seen, on inspection after awhile, that the motion of the corpuscles grew slower and slower, and finally ceased. The more rapid the vibration before the withdrawal of light, the longer the period of activity of the corpuscle in the darkness until it became motionless, and, *vice versâ*, the slower

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[1] "Die Heilkraft des Lichtes," Leipzig, 1898.

[2] "Der Einfluss des Lichts auf den tierischen Organismus," Diss., Berlin, 1898.

[3] *Beiträge zur Physiologie der Flimmerbewegung*, Separat-Abdruck aus d. *Archiv für die gesammte Physiologie*, B. 78, Bonn, 1900.

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and weaker the vibration of the ciliæ, the shorter the time up to the cessation of all motion.

When a corpuscle that had been kept in the dark, showing no motion whatever, was exposed to bright daylight again, the oscillation recommenced, after a latent period, depending upon the duration of the exposure to darkness. The longer the corpuscle remained in the dark after it had become motionless, the longer it continued in a quiescent state until the resumption of oscillation. This could be repeated several times, but soon a sort of fatigue was noticed in the corpuscle. This showed itself also when the corpuscle was kept too long in the dark.

What do these important investigations of Bergel mean? Are they not in contradiction to our daily experience? The cessation of the movement in the dark seems to be opposed to the real conditions of life, as in the animal, or at least in the higher animal, the ciliated epithelia are in dark regions of the body, and, notwithstanding this, are in constant motion. We would mention here that in a series of experiments on ciliated corpuscles, no cessation occurred, and these were the ones that moved quickest before they were put in the dark chamber. The light-stimulus, it seems, shows its effect only on exhausted ciliary corpuscles, which are no longer in full possession of their vitality. They still move on irritation: that is, when light is thrown on them. But when the stimulus ceases,—that is, when they are brought into the dark,—then they sooner or later cease to oscillate. Now, inasmuch as light acts as a stimulus upon the movement of the ciliary corpuscle, this is, according to Bergel, nothing but a proof that the ethereal vibrations of light have an influence upon the chemical processes within the corpuscle,—they cause chemical changes, which are transformed into motion, or, in other words, into labor. Now we can understand the first experiment by Moleschott. Every action of the organism is accompanied by the chemical process known as oxydation. The more activity, the more oxydation; the more light was thrown upon the frogs, the more oxygen they consumed and the more CO_2 they gave off, and all this only through the greater activity of the ciliary bodies. In pathological conditions there is an accumulation of metabolic material, which cannot be eliminated nor replaced by new nutritive elements; therefore the action stops, as the ciliary corpuscles are, so to speak, paralyzed.

In this connection I have to mention what is probably well

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known to all of you, that the actual labor done by these ciliæ in the human system is enormous. If, according to Justus Gaule, you excise in a frog just killed the mucous membrane of the pharynx and œsophagus, splitting open the latter and pinning the whole membrane on its edges on a piece of cork, if you then put small particles of soot or of cork or similar substances, dipped in a physiological salt solution upon it, then you can see how these particles are carried away until they finally reach the stomach end of the œsophagus. Small as is the force of a single cilia, so enormous is the total effect of their immense number (Engelmann).

In the example just mentioned the current of the ciliæ is in the direction from the mouth to the stomach, as it is the function of the mucous membrane of the digestive tract to transport substances into the organism. The current is just the reverse on the mucous membrane of the respiratory tract: that is, from the bronchi to the nares. This is natural, as here there is different work to accomplish, namely: to carry the dust-particles, etc., out of the organism. This work is initiated in the cells by the ciliæ nearest to the bronchi; then the others follow suit. Thus, with "great intelligence" they sweep out during the night the dust that is inhaled during the day-time, and in the morning it is found deposited at the entrance, and with a little hawking, etc., it is easily removed.[1]

In tuberculous affections of the respiratory tract there is nearly always a concomitant catarrh present, with more or less mucus. Sometimes this is present in enormous quantities. That such a superabundant secretion should prevent entirely the oscillation of the ciliæ is very plausible. On the other hand, if this is present in a smaller degree, it will *paralyze*—as I understand it—*temporarily the action of the ciliæ*, and in such cases a stimulant like light will overcome this paralysis and the ciliary corpuscles will be able to resume their work. The metabolism of the cells will return to the normal, and coincidently not only the mucus, etc., will be removed from the bronchi, but, in my opinion, also the end-products of the tubercle bacilli, and undoubtedly a great many of these bacilli as well. This would be the ideal cure of the disease. Alas, it is not always accomplished; but in many cases this beneficial effect, in part, is produced, without doubt.

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[1] See Gaule's "Physiologie der Nase," in Heymann's "Handbuch der Laryngologie," p. 161.

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But has sunlight not a direct influence on the bacilli? We know now that it has, and I agree with Albert Abrams, of San Francisco, when he says[1]: "The value of sunshine in localities adapted to the treatment of consumption is greater than is generally believed. That this value is dependent, in part, upon the germicidal action of the solar rays in the atmosphere, I am confident. I have made a number of experiments to test the influence of solar-heated atmosphere on the growth of tubercle bacilli in culture-tubes. The results demonstrated that, while such atmosphere was not destructive to the growth of tubercle bacilli, it nevertheless retarded their development." I have not hesitated to quote even such a conservative statement before you, although I am aware that the experiments of other authors have shown a still greater germicidal power of the rays of light. It naturally depends at what time you use the sunlight for such purposes.

I myself was led to study the effects of light, and especially electric light, on the diseased tissues, in a very curious manner.

In 1889 I had the honor to demonstrate before the New York Academy of Medicine (Section on Laryngology) the transillumination of the larynx. One of the patients whose larynx I had frequently examined asked me one day whether I no longer employed "electricity," which always benefited her. As such patients who suffer with intense pain are usually not hysterical, I was constrained to give this matter my consideration. I applied the "electricity" by alternately placing the Voltolini light, modified by me, upon one or the other side of the larynx or upon the pomum Adami. As this lamp has, in the meantime, probably fallen into disuse, I will repeat here my former remarks[2]:—

"The casing contains an Edison incandescent lamp and in front of it a ball filled with water, which is similar to the globe commonly used by shoe-makers, and subserves the double purpose of first concentrating the light by acting as a biconvex lens, and secondly of protecting the exterior of the neck from too-intense heat. I have taken the liberty to make a few minor changes in this apparatus. In the first place, I have increased the amount of light by using a higher-power lamp. It also appeared to me that in some patients with a large pomum Adami many of the rays of light were lost.

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[1] *Philadelphia Monthly Medical Journal*, March, 1899, p. 175.

[2] *Medicinische Monatsschrift*, November, 1898.

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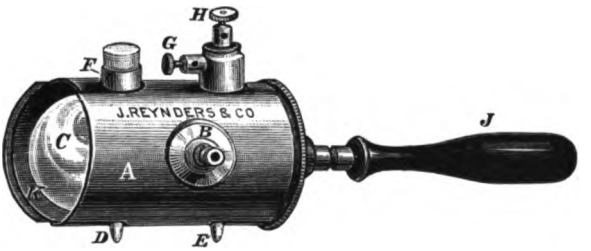
For this reason I had the front part of the apparatus *K* (see figure) hollowed out and covered with rubber, so that it adapts itself better to the external contour of the neck. A handle (*J*), which can be attached to a posterior or lateral surface (*B*), seemed to me useful. Finally I had the globe more firmly attached (*D* and *E*), in order to protect it from breakage."

I then applied this lamp to one or both sides of the larynx and also in front, and usually allowed it to remain at the place of application until this became heated, ordinarily about five minutes. Several times I observed a formation of blebs after five to ten minutes.

At first I did not attribute any significance to this treatment, as I was at a loss for an explanation. Not until 1891, when I read the address made by Robert Koch before the International Congress in Berlin, was the matter clear to me. Koch referred to the influence of sunlight upon the tubercle bacilli: a view which was soon



adopted by Mignano[1] and others. Later Minck, a scholar of Buchner, Santori, Marshall Ward, and a host of other investigators demonstrated the same influence of electric light upon bacteria.

If, therefore, sunlight as well as electric light accomplishes all that which has been demonstrated by most eminent investigators, there remained only for decision the question whether light actually penetrates the tissues of the larynx. This could not appear doubtful to me, since I had examined hundreds of patients by means of transillumination, and had been able to see distinctly the interior of the larynx. It seemed to me that if any portion of the body were adapted for testing the influence of electricity, it must be the larynx.

My expectations were not entirely fulfilled, and I would ascribe this to the incompleteness of my apparatus, which only permitted

[1] *Archiv für Hygiene*, B. 25.

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me to apply the electric light for about five minutes to the diseased parts, after which it became too hot. Notwithstanding this I had some encouraging results, of which I would communicate the following:—

CASE I.—Mrs. R. H., 30 years old, mother of four living children, pregnant. Has suffered four weeks with pain in the throat, especially on swallowing. On retiring she has a feeling as if "oil were boiling in her throat."

Status præsens, February 24, 1892: Phthisis incipiens of both lungs. Mucous membrane of larynx very anæmic; slight ulcerations on the epiglottis and on the right ligamentum aryepiglotticum. I administered creasote with tincture of gentian (equal parts) in increasing doses until she took 70 drops three times daily. Besides this I applied the electric light to both sides of the larynx.

March 10. Up to this time the patient had only appeared every week. The sensation of "boiling" in the throat was better after each application of the electric light, but the improvement only lasted for a short time. Later it was still troublesome enough to disturb her night's rest. From now on she calls every second day for treatment.

April 15. The peculiar sensation described is still present, but much less marked; the pain less.

April 27. The sensation still present at night; pain inconsiderable.

June 5. The ulcers in the larynx have healed; she feels much more comfortable; no sensation of "boiling" in the throat at night; no dysphagia, but some cough.

June 20. Delivered of a child, and feels comparatively well.

June 26. Had a violent pulmonary hæmorrhage; and died two days later in consequence.

CASE II.—Mrs. M. S., 23 years old, had one living child. She has a feeling of rawness in the chest, and complains of dysphagia.

Status præsens, November 7, 1893: Phthisis pulmonum. (Cavity of the size of the palm of the hand below the right clavicle.) Acute pharyngo-laryngitis. Infiltration of both false vocal cords. Curettement refused.

November 17. She was given codeine, creasote, and application of the electric light, the latter thrice weekly. Swallowing is much better, and she requests further application of the electric light.

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November 24. Condition of the larynx is the same, although patient asserts that she is feeling better.

December. Patient feels quite comfortable, and travels to Lakewood and then to Georgia, remaining away altogether ten weeks.

March 22, 1894. Patient had felt quite well up to a week ago, when she was seized with a violent cough, and also with a return of her former dysphagia. She was treated in the same manner as before.

May 10. She had again improved so much that she was able to make a trip to the Adirondacks.

The patient had been under treatment of various laryngologists and stated that nothing acted as well as the application of the electric light. I have heard nothing further from her, but she is said to have died in the Adirondacks.

CASE III.—Miss L. B., 19 years old, singer. Had a hæmorrhage about one and a half years ago, coughs a good deal, has pain on swallowing, and has been hoarse for four months.

Status præsens, November 25, 1895: Phthisis pulmonum, both apices being affected. Larynx: Epiglottis somewhat infiltrated. Deep ulcer on the left chord. Treatment: Creasote, codeine, antifebrin occasionally for the fever, and every second day application of the electric light to the left side of the larynx. Under this treatment she improved considerably; so that after three months, on February 28, 1896, the ulcer had healed and the patient was absolutely free from pain.

September 3, 1896, I again saw the patient, and found her in excellent health after a sojourn of six months in the country. The pulmonary affection was cured and no tubercle bacilli were found.

January 6, 1897. Coughs again for the past eight days, and is troubled with slight dysphagia on the left side. Superficial ulceration on the epiglottis (left side). Acute laryngitis and diffuse bronchitis. The ulceration was obstinate, and she was not restored to complete health till after the lapse of fourteen weeks' (irregular) treatment.

I saw her again in December, 1897, and also in March, 1898, and was able to demonstrate a permanent cure.

I have since had my apparatus changed. In order to get only blue rays from the light I filled the little glass bottle, instead of pure water, with a very dilute solution of methylene-blue. This

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gave me a nice blue color. As the metallic end of the lamp still became very hot by radiation, I attached a hard-rubber piece at the end of it, and in this way the apparatus remained cool, and the patient did not feel any annoyance from the heat. Still, the water became so hot that once it drove out the cork, spilling the hot water over the bare chest of the frightened patient. After that occurred I modified this instrument again, and you see here the apparatus which I use now. Instead of the glass bulb filled with colored water, I simply insert a disk of colored gelatin or glass. In this way I have overcome all difficulties. I can apply the electric light as long as I wish, and I must say the results so far are very encouraging.

These results demand consideration for a method of treatment which is so agreeable to the patient and so free from all injurious effects as phototherapy. We do not delay a moment in subjecting the patient to pain, if it can only be assumed that some relief is thereby afforded to him. Have we not all of us caused severe pain by applying lactic acid and in using the curette, as well as other methods, all without avail? Therefore, since the majority of my patients ask for the continuation of the treatment with the electric light because of the benefit which they ascribed to it, am I requesting too much in urging you to add this method to your therapeutic resources?

After having for years used the electric light for tuberculosis of the larynx it was natural to give this a trial also in tuberculosis of the lungs. I have mentioned above that the electric arc light is the one which has produced, according to different German authors, the best results. I did not apply this in tuberculosis of the throat, as my results with the incandescent lamp were quite satisfactory. Besides, this lamp could be applied better to the larynx. It is different with the thorax; here we would have to place the patient in a box provided with a great many incandescent lamps, and the heat produced in such a cabinet would not be beneficial to tuberculous patients. I therefore resorted to the arc light, which I have applied in several cases. Encouraging as the results appear to be, I am not prepared to give you the histories of patients thus treated, nor can I present a definite opinion, for one very important reason, viz.: the instruments used up to the present time have not attained that state of perfection which they ought to have, and which I think can be reached easily. For the last twelve months I have been trying to have a more perfect apparatus made, but regret to say that I did not succeed as yet. It is the hardest work to get a new electrical

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instrument made here in this city of Greater New York, although we are overflowing with electricity. Still, I hope I shall have it finished in the near future, when I shall report my further experiences. But even now I am able to say that we have, in the chemical rays of the electric light, a healing power which promises to be of the greatest value in the near future. The results so far achieved can no longer be ignored, and it has become our duty to further investigate these processes.

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REPORT OF THE PRACTICAL VALUE OF CROTTE'S METHOD, AND OF THE METHODS OF OTHERS WHO ADVERTISE CURES.

By Egbert le Fèvre, M.D., New York.

One year ago this method of treatment was tried experimentally in St. Luke's Hospital, New York City. Both in-patients and out-patients were selected, and careful records were kept, including the local and general physical condition, the number of the tubercle bacilli, and the toxicity of these bacilli. The treatment was kept up continuously for three months. By the first stage of tuberculosis I mean cases showing well-marked signs of consolidation and tubercle bacilli in the sputum, but no evidence of cavity-formation. A number of these cases were treated by this method, and in none was any curative effect obtained. The local process was not modified, the physical signs did not abate, and in two cases there was a well-marked aggravation of the local signs after two weeks of the treatment; so that later on the treatment was discontinued in these patients. In another case there was no effect on the physical signs, but the tubercle bacilli increased in number, and animal experimentation showed that there had been no effect on the vitality and virulence of these bacilli. In three other cases in the first stage there seemed to be for a few weeks a beneficial effect. This probably could be accounted for by the enthusiasm of the patient. The improvement was, however, no more than had been observed during the stay in the hospital under the same hygienic and dietetic treatment. Of course, during the trial of this method all other treatment, except symptomatic treatment, was discontinued. A case of glandular tuberculosis did very badly under the electrical treatment. Over the glands iodine was painted, and this, together with the electrical treatment, caused violent irritation, and necessitated a surgical operation. This case was rather instructive. She entered with a rather mild process in the lungs and glandular involvement. With the breaking down of the glands there was rapid softening of the lung, and the case ran a very rapid course of general pulmonary tuberculosis. Whether the lighting up of an inflammatory process in the glands and its subsequent suppuration were accountable for this is a question.

Cases in the so-called second stage—*i.e.*, where there is beginning softening—were not improved by the treatment. There was

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no permanently good effect so far as the temperature was concerned, and the cases ran the ordinary course. There was absolutely no effect on the septic infection.

In the advanced cases of tuberculosis the treatment apparently did harm. In one case which had been in the wards for eighteen months, and in whom the process had apparently been arrested for a considerable time, after six weeks of the treatment there was a rapid breaking down, and the patient died four months after the cessation of this treatment.

This treatment was continued for three months, and then, on report of the results obtained, its use was abandoned, as the claims made by those who were carrying it out had not been substantiated in any form.

A static machine was used in connection with an apparatus invented by Crotte. In this latter machine there was supposed to be formalin, which was acted upon by the electric current and carried by cataphoresis into the patient. The patient was put on an insulated stool, and a towel wrung out of a mild solution of formalin was spread upon the chest. The current was then passed, and was supposed to carry this preparation into the lung. A solution of iodine in spirit of camphor was also painted over the portions of the chest corresponding to the diseased area of lung. The pathologist could not detect any absorption of iodine after this treatment.

GENERAL DISCUSSION ON ELECTRICITY IN TUBERCULOSIS.

DR. J. L. HATCH (present by invitation) said that, in some cases in which tubercle bacilli were present in association with a mixed infection of staphylococci and streptococci the tubercle bacilli could not be found after three months' treatment, though the other infective agents were present. In one case particularly, where there were as many as six hæmorrhages in one week, there had not been a hæmorrhage since the treatment. A number of the patients whom he had seen under this treatment are to-day in good health, and are witnesses of what has been done for them.

DR. G. BETTON MASSEY said that at the last meeting of this association, in Washington, D.C., he had reported on a new method of treating tuberculosis of the glands of the neck, and wished now to supplement his remarks made at that time. His remarks would refer only to the treatment of external deposits of the bacilli. The method was a modification of that used by him in the treatment of cancer for the past six or seven years. This method is a very direct and definite way of killing the tubercle bacilli after they have settled in the glands of the neck. It consists in making a small opening into the gland large enough to admit an electrode of 18-carat gold not much larger

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than a hypodermic needle. This electrode is amalgamated at the end, and is insulated where it passes through the skin. In the two cases reported by him he had kept this opening patent by treating it first with an uninsulated amalgamated zinc electrode. The object was to produce enough oxychloride of mercury, by electrolytic destruction of the metallic mercury on the electrode, gradually to asepticize the gland. His results had been excellent. At the time of the former report one case had first received the treatment four months previously. There had been four treatments. In the other case he had treated two glands through different openings. The current employed had varied from 3 to 10 milliampères, and fresh mercury had been put on at each application. The treatment had been repeated two or three times a week and had been accompanied by some slight discharge, but the patients had not been prevented from continuing at their usual occupations. At the end of six months nothing but slight indurations had been left to mark the place of the large glands. Even these had now disappeared, and the general health had improved. Both patients led sedentary lives, being stenographers. In one case there was a chain of enlarged glands, but, owing to the fact that the mercuric salts had been transmitted by the lymphatic current downward, these glands had become smaller. The speaker urged that this method of treatment be employed for destroying the tubercle bacilli in cases of local tuberculosis in almost any part of the body, except possibly the cranium, the thorax, and the abdomen. He believed it to be a quick and satisfactory method of improving both the local and the general conditions.

DR. R. REYBURN, of Washington, D.C., thought it was not at all essential to use a gold needle in the method just described by Dr. Massey. In several instances he had employed an ordinary needle with the current of 10 or 15 milliampères. In these cases he did not open the skin at all, but attached an ordinary needle to the positive pole, and pushed it into the tissues. One case had been treated about three years ago, there being two or three tuberculous glands varying from one inch to an inch and a half. The patient was treated at intervals of about one week for six months. The tumors had entirely disappeared, and when seen quite recently there had been no trace of the former trouble. The speaker said he believed that the application of the electric current itself was responsible for the setting up of an active inflammation and the resulting local necrosis. Fortunately, the tubercle bacillus itself is not very virulent, and becomes encysted by the inflammatory action artificially induced by the current. He was of the opinion that it was much better to operate without making an opening into the skin, as by the latter method a new channel of infection was opened. He had probably treated six or eight cases in this way, and had been much pleased with the results, although, of course, the method was rather slow.

DR. MASSEY agreed with the last speaker that there was a resolving action from the negative pole, and he assumed that it was this that Dr. Reyburn had used, because if he had employed the positive pole it would have stained the tissues with iron. He had tried this simple use of electricity, but had failed in one or two instances completely to dissipate the tumor, and hence had resorted to the germicidal method referred to by him. It was a

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safe method even in a large cyst of the thyroid gland. There was absolutely no danger of sepsis under these circumstances.

DR. REYBURN remarked that he had intended to say that he made use of the negative pole.

DR. WILLIAM J. MORTON, of New York, said that he had always been grateful to Gautier for introducing metallic electrolysis into medicine: the use of different metals and the production and transmission of the oxychloride into the tissues. Dr. Massey deserved credit for his specific use of mercury. He would disagree with Dr. Reyburn in saying that an ordinary iron or platinum needle at the negative pole would produce any such extensive result as could be secured by metallic electrolysis. He had made many experiments with different methods, and had proved this assertion by the distance to which the tissues were stained. He had, however, been disappointed with the extent of the metallic diffusion into the tissues. In his opinion, the diffusion was so limited that, while an improvement on former methods, a large number of operations were still necessary to destroy and modify even a small area of tissue. For this reason he was not as enthusiastic about metallic electrolysis as he had been at one time.

Regarding the Crotte method of treating consumption, he would say that Crotte had made a very serious attempt to secure the approval of his method by the medical profession. Dr. Morton said that an Englishman had come to him about a month ago with the statement that he had a friend in England whom he was anxious to see get well of his pulmonary tuberculosis. The question was put to him: "Would you favor trying the Crotte treatment?" The information was offered at that time that the man would not be received at the Crotte institution without putting down one thousand dollars in advance. It became, therefore, a serious question for the profession to answer. Dr. Morton said he had then gone to St. Luke's Hospital in this city, where Mr. Crotte was practicing his method, and had seen there an excellent static machine of modern home manufacture. On the opposite side of the room was a cumbersome French machine, with ebonite cylinders: the Lewandowsky machine. Patients were being treated at the time with both machines for each case, and he could certainly vouch for the vigor with which the electricity was applied from the home machine, for the sparks were flying freely. He had then tested the French machine, which was said to be giving the cataphoric effect, but had been unable to secure any spark or evidence of electrical charge whatever. A feeling of doubt had been aroused when his companion had vouchsafed the information that the American machine had very little to do with the treatment, as it had "no cataphoric power," and that for this latter purpose the French machine, which to his knowledge was inoperative, was relied upon. These observations had led him at that time seriously to doubt the efficacy of this new treatment, though looking at it from an entirely different point of view from that taken by Dr. le Fèvre. Dr. Morton then suggested that a committee be appointed to search for any definite proof that formalin-vapor, or any similar substance, can be made to enter the system by the aid of electrostatic discharges of electricity. He hoped a committee would be appointed by the association to examine into the alleged electro-physics of the Crotte method, because he wished to be thoroughly fair. He was willing to

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believe that intelligent treatment with static electricity would produce a gratifying improvement in the general condition of the patient. Its use for this purpose was founded on solid and well-known principles. Mr. Crotte should prove to us that iodine or the products of formaldehyde or other medicaments can be, in this manner, really introduced into the human system in health or in disease.

DR. LE FÈVRE said that it was understood that the physicians at St. Luke's Hospital should carry out a series of experiments, and this had been done to the best of their ability. When the pathologist had reported that these substances could not be proved to enter the system of the patient, Mr. Crotte objected to the person carrying out the investigation as incompetent. Mr. Crotte's chemist was then allowed to carry on the investigation, and he too had failed to prove that any medicinal substance could be introduced into the system by the treatment. The treatment had been abandoned because apparently useless, and the claims of the inventor had not been proved. The experimentation had been carried out with all sincerity, and he was sorry that his name, and that of the hospital, had been dragged into this affair.

DR. MORTON remarked that there could be no question of the cataphoric power of the current to introduce medicine under proper conditions. He had, however, never heard of vapors being introduced into the system by electricity. Dr. Morton then moved that a committee of three be appointed by the president to report on the electro-physics of the Crotte method, and in this connection to read the paper submitted in French to this association by Dr. Hatch.

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SYMPOSIUM ON ELECTRICITY IN GYNÆCOLOGY.

THE TREATMENT OF UTERINE DISEASES WITH ELECTRICITY.

By Prof. Félix la Torre, of the University of Rome.

Development of Uterine Electro-Therapeutics.

Among the most important and happy applications of the electric current in a diseased organism is that which we now employ to cure the diseases of the uterus. It is also one of the most useful. I will not tell here the story of the different vicissitudes which electricity encountered in obstetrics, as a therapeutic agent in general, nor of those attending its use in gynæcology. These are questions of these later years very well known to you, and constitute an interesting story. The criteria to which we apply the electrical energies to-day are very different from those employed formerly. Indeed, without exact knowledge of the sort of action electricity had it was employed now as a direct and again as an interrupted current, during the last century, but without any exact criterion. When Apostoli introduced, in 1882, the employment of the constant current in large dosage, certain physicians, conceiving the most exaggerated hopes, made use of electricity in almost every case of genital disease. There was consequently a great abuse of this kind of treatment, as always happens when a new invention inflames the mind with enthusiasm; but soon it came to an unreasonable ending, because the rational use was followed by disillusion and even reverses. As soon as one got, little by little, to know the failures, on one side, and by obtaining a favorable clinical experience, controlled by time, on the other, we could see how, in those different morbid forms of the uterus, electricity was found very useful, and could be applied without fear, when given in exact applications, so as to avoid danger of any kind. To-day we can affirm, conscientiously, that, even if the exact scientific knowledge of the mode of action, with its different forms of applications, is wanting, we have, nevertheless, a clinico-therapeutic criterion which leads us, with sufficient certainty, to an effective employment of the electric current in uterine diseases, so that we might very well use it. Since in many cases of organic diseases of the different parts of the body electricity is indispensable in order to make a diagnosis or to cure an injury, so it will also be

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of great use in genital diseases, being a precious aid for diagnosis and a powerful therapeutic agent in uterine affections.

In the last century and till the middle of the present one, the electricity employed was always the static, but never the intra-uterine pole. We explain it easily, knowing that antisepsis did not exist in those times. The gynæcologists gave no exact indications about the application of the pole, which was applied without any criterion: here and there on different parts of the patient's body. And nobody has ever understood what therapeutic idea the electrical action in these days was based upon. Indeed, Friedenthal was the first who used, in 1869, the direct current, and Wittekier spoke, in 1874, of the pole introduced within the uterine cavity. But certainly they would not have made any progress in the matter if two events had not occurred to change the direction of therapeutic effort. This change is to be attributed, first, to Apostoli, who discovered the method for diluting the caustic power of the pole, applied on the abdomen, thus reducing it to an indifferent state, and thus wrought a substantial modification in the technique. On the other side, we are debtors to the great Lister, who, discovering antisepsis, gave us the ability to try every intra-uterine medication. From that time the faradic current was greatly preferred. They applied it a great deal, and even abused it. For a long time the faradic current only was employed in uterine diseases.

Forms of Current Used and Results Accruing.

But with the biological study of the electric current progressing in a wonderful way, and especially with the inquiries and experiences of Prof. d'Arsonval, one has seen how the diseases of the genital apparatus are favorably influenced by an electric current applied in different ways. We have at present five methods of gynæcological electrification recognized in detail:—

I. The constant, or direct, current. (Apostoli.)
II. The current of high frequency.
III. The undulating current.
IV. Cataphoric medication.
V. The faradic current.

I. Constant Current (Apostoli).—There is no physician today who is not aware of the method of Apostoli, even in theory, and least of all you gentlemen. Consequently it is superfluous to speak

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of it. I wish only to make an observation. Some say the method of Apostoli is an electrolytic electrification; others say that it treats of galvano-caustic activity; and many long and tiresome discussions arise from time to time on these two opinions. If I am not wrong, the method of Apostoli should be classed as an electrolytic galvano-caustic method. Employing a few milliampères we obtain an electrolytic action, while a high dose of milliampères produces certainly a caustic action. The two opposite opinions can be reconciled by regarding the differences as dependent on degree of action. This is the method of electrification I use the most frequently, having the best results from it.

II. Current of High Frequency.—From his experiences and inquiries on the physiological action of the currents of high frequency d'Arsonval draws the following conclusions:—

1. We have analgesia of the parts through which the current passes by filling the skin with millions of sparks.

2. An action is to be seen on the nervous system characterized by a very marked depression of the arterial circulation.

3. Increasing respiratory combustion, it has an action upon nutritive changes, which proceed with more intensity in the interior of the tissues. The cellular activity therefore is stimulated.

4. An attendant action is obtained on the cultivation of microbes.

For these reasons d'Arsonval discovered in the current of high frequency a true and exact influence upon the affections attributed to insufficiency of nourishment; and many who made inquiries of this kind in different diseases obtained always results of value.

Mangin desired to use the current of high frequency in gynæcology and to obtain in the local organs the same effect which is reached generally on the whole organism. He used for his applications the apparatus of d'Arsonval, which is made by the high-pressure coil of Ruhmkorff united with condensers by means of a solenoid, the currents communicating with its extremity. The current is introduced from one pole into the vagina or into the uterus, and the other pole is applied on the abdomen through a wet electrode. According to the intensity employed, it has the following effects, viz.:—

1. Analgesic action, showing the surface.
2. Stimulation of the general trophic functions.
3. A local action of dilatation.

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For the analgesic action it was found that it was applicable to cases of tubular collections without reaction; also in the cases of parametritis with exudations which surrounded the uterus and adnexa, or where ovarian or dysmenorrhœal pains were caused by the absence of menstruation.

Like d'Arsonval, Apostoli, Charrin, Boinet, Pudin, and many others, Mangin has made use of the current of high tension, attributing to the fact that it heightens the combustibility and the vitality of the tissues by stimulative influences akin to those which electricity produces on growing plants when they are submitted to its prolonged action. He resolved to apply it in those cases of inflammatory exudations which are not infective with the purpose of absorbing them more easily after the resumption of nutritional activity. The exudations disappeared. This absorption is due to the re-enforcement of phagocytosis and to acceleration of vascular motion in the lymphatic and sanguineous circulations rather than to the nutritive action and the attenuation of the microbes.

On the other hand, we can compare the resolvent action of the current with that which we obtain through different means: blisters, electro-punctures, local arteriotomy, and iron injections. They all produce great exaltation of phagocytosis.

Knowing the action of the current of high tension on local dilatation, Mangin used it in amenorrhœa and in insufficient menstruation, with excellent results, especially in those cases in which the emmenagogues did not prove effective. In two women affected with amenorrhœa menstruation reappeared, and they became pregnant after having been sterile.

III. Undulating Currents. — After d'Arsonval's studies on the sinusoidal alternating current Apostoli made, in 1896, inquiries and gained experiences on these currents with regard to gynæcological diseases, which no one had studied up to that time. Apostoli presented the results of his inquiries in 1897, first to the Electro-Therapeutic Society, then to the Académie des Sciences at Paris, and finally to the Congress at Moscow. Looking at this apparatus of alternating sinusoidal currents constructed by d'Arsonval, Apostoli says, speaking from one point of view, that it is very easy to obtain a current of the same kind, but without any change of direction. One has then an electric wave, starting from zero, whose intensity is always increasing till it reaches the maximum, and returns down to zero. A new wave follows; but this one, being in the same direc-

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tion, does not change, as happens in the alternating sinusoidal current, and produces a regular and geometrical curve.

Some chief qualities derived from this property can be managed in the physiological camp: that is, the undulating current combines, perhaps, the effects of the galvanic current with those of the interrupted current, although the latter current is not a faradic, but a sinusoidal, one. In this way we have an electric wave which is not alternating, but always follows one direction; which has electrolytic properties, but at the same time a lighter effect, which is less irritating and better tolerated than the ordinary faradic current.

Apostoli, having thus given the basis of the character of the undulating current (association of polar electrolytic action of constant direction, with variable state, and an especial curve), applied this new electrical method to therapy in general, and to gynæcological therapy in particular.

The undulating current was employed in two different manners: 1. Introduction of the active electrode covered with wet cotton into the vagina. 2. The electrode consisted of a uterine sound of platinum introduced into the cavity of the uterus or in the cervical canal. In both cases the indifferent electrode, being positive or negative according to the case, was formed of a cake of clay applied over the abdomen. The duration of each *séance* was five minutes daily in vaginal and every two days in intra-uterine cases. The smallest dose varied from 10 to 25 milliampères, 1800 to 2500 periods each minute. The least voltage will rise from 15 to 25 volts. The applications are well tolerated, and they prove that women prefer the undulating current to the galvano-caustic and faradic. In ordinary cases, as Apostoli says, the indications are generally the same for the galvano-caustic: the positive for non-congestive and the negative for congestive cases.

Apostoli and his assistants made, during fourteen months, from March, 1896, to May, 1897, 3242 gynæcological applications on 224 patients. Forty-five of them did not follow the treatment for the necessary time; consequently we have but 183 patients on whom we may study the results.

The undulating current was applied in several cases of genito-urinary diseases and also in the pseudotubular peritoneal cases; but in the uterine diseases on which I fixed my attention we find that Apostoli treated with the undulating current several cases of myo-fibromata with periuterine exudates, subinvolution, hæmorrhages,

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menstrual irregularities, amenorrhœa, leucorrhœa, metritis, and endometritis.

The results varied. From the symptomatic point of view, those of the fibromata were always excellent, and from the anatomical point of view the undulating current is inferior to the galvano-caustic, because one very seldom saw a diminution of the tumor, while, on the contrary, the volume of the neoplasm very rarely grew.

The exudates disappeared rapidly and totally, and recovery was seen in cases of subinvolution.

Hæmorrhages and leucorrhœa reappeared even when they had already ceased for a short time, and increased in intensity, after the application of the electro-vaginal current in usual dosage. While increasing the intensity of the current and applying the electrode within the uterine cavity, hæmorrhages were influenced, but not as well as with the galvano-caustic. We find, however, the energizing benefits of the undulating current in hæmorrhages subsequent to delivery or miscarriage. The effect of the undulating current in the irregularities of menstruation has been of little use, and quite indifferent in the treatment of amenorrhœa, for whose particular treatment remains the negative galvano-caustic.

In cases of endometritis the influence is not always either visible or constant. In metritis the undulatory current has variable effects: The amelioration is as manifest as when the galvanic current is employed in the cases where the forms are only congestive. On the contrary, they are not modified when they reach high altitudes. Nevertheless one has never observed by the undulating current the quick absorption of the cervical hypertrophies in cases of chronic metritis, while this is obtained quite evidently with the galvano-caustic current. These few considerations show us clearly how the undulating current, being highly electrolytic, remains inferior to the galvano-caustic and to the faradic current, but still is better tolerated because of its analgesic power. It can be used in lesions of light character, but not in those which require 50 and more milliampères. In conclusion, we consider it only as another remedy in the conservative treatment of uterine diseases.

IV. Cataphoric Medication.—Dr. Boisjean du Kocher makes use of the electric current to obtain, through its electrolytic action, a medication with oxychloride of silver. Thus, as I said, he treats many diseases of the genital apparatus, like metritis, uterine hæmorrhage, and some cases of salpingitis. He discovered, also, that

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several cases of pyosalpinx disappeared in consequence of their modifications through natural channels.

V. THE FARADIC CURRENT.—What the faradic current means, how one obtains it, and what its technic is are known to you; consequently I do not take up your time with this subject. I will only say that the faradic current is an excellent remedy, when one applies it to obtain a local contraction of the uterus and also for its analgesic power in ovarian neuralgias.

WHAT IS THE ACTION OF ELECTRICITY?

If we consider all we have said about the physiological and pathological action which electricity exerts on the organic tissues, it will be seen that it exalts or depresses the vital processes, and thus controls nutrition. It is, therefore, easy to understand how the electric current can be very useful in those cases of uterine morbidities in which the most appropriate medical and surgical treatment cannot give as excellent results as are shown by electricity. Thus I think that, in every pathological condition of the uterus whose chief anatomo-pathological fact is hypertrophy and hyperplasia of the muscular elements,—as happens in metritis, in a neoformation, or in a simple vascular dilatation, as in endometritis,—the electrical energy, whatever its form may be, will impress on those elements such modifications as to awaken in them greater vitality than usual, and the thus excited tissue will provide a better nutrition and lead to a return to their primitive physiological state.

It can be asserted that the electrical energy does not only exterminate or neutralize the infective power of the germ, but it awakens also the phagocytic power of the diseased local economy. From this point of view the electrical treatment results better than the medical or even the surgical in its therapeutic effects. If, for instance, we think of all that happens in the scraping of the uterine cavity in fungous endometritis, and that which happens to the same lesion after an endo-uterine electrical application, we could be sure that, in the first case, we might remove more or less completely the first stratum of the mucous membrane, while, in the second, the whole mucous membrane is influenced as well as the muscular tissue.

COMPARISON OF SURGICAL AND ELECTRICAL TREATMENT.

What happens after the amputation of the uterus and in the treatment of metritis, and what when we apply the electric current

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to cure it? For the first case the uterus bears, through a kind of revolution, a limited involution, in which the organ is much reduced, but never as much as can be produced by means of the electric current, which impresses on the organ an increase of vitality and a modification in nutrition. But, there is more to say. It is generally admitted to-day and perfectly well known, that endometritis, metritis, parametritis, and inflammations of the genital apparatus depend on infection, which is principally brought on by the gonococcus, streptococcus, and other isolated and associated germs. Apostoli and others demonstrated that the electric current kills the infective power of those micro-organisms and heightens that phagocytic power which surrounds microbes and kills them. Indeed, through the antiseptic power of electricity we are enabled to introduce the sound into the uterine cavity any number of times for electrical treatment, without causing any infection, while infection happens so easily and so often when we introduce any instrument for diagnosis or ordinary treatment and not in communication with electrical energy. Therefore we have recoveries more complete in endometritis and metritis, through the application of electricity, than by medical or surgical means. With the scraping of the cavity, especially when it is made dryly, instead of being under the continual antiseptic douche, as I do, through the irrigatory spoon of Auvard, we do not only not remove all infective elements, and do not even render them harmless, but we can ingraft them on a new surface, while the passage of an electric current through the uterine tissues kills the power of the infecting germs living within them.

With the medical or surgical cure, even well prepared with antisepsis, one does not completely fulfill the causal indication, while this indication is perfectly well met by means of electricity.

To this matter I call your particular attention. The electrical treatment in uterine diseases is recommendable for another reason—I would say, in a social sense, not to be neglected in practice—that is: the surgical treatment demands often a more or less long time lying in bed, while the electrical treatment can be managed without either bed or rest, and without any change of usual life or work. This circumstance is of the greatest use in daily practice, chiefly in those cases in which the patient cannot remain a long time laid up.

Although surgical intervention is more brilliant in its immediate therapeutic effects and though electrical treatment needs often a long time and much perseverance, yet the results of the latter are

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better and more satisfactory. Therefore I advise and practice in some cases an electrical *séance* after surgical intervention, and the results show clearly to me this electric-surgical union acts powerfully in the treatment of metritis and endometritis.

If electrical energy is of the greatest service to the therapy of many diseases of the uterus, it does not do the same in others. Thus, we can say, in general, that it is detrimental in all bad lesions, as malignant cancer, deciduomata, myxomata, etc., and in some states of fibromata, as the cystic forms, softened fibromata, etc. All these morbid lesions must be treated most radically with surgical means if possible.

Electricity as a Diagnostic Agent.

Electricity can be applied with profit, not only as a therapeutic agent, but as a diagnostic means, because the current determines by the production of pain the presence of inflammatory or suppurative conditions of the appendages which by manual or clinical examination, even if very well done, could not otherwise be ascertained. Thus, Apostoli could make a diagnosis of the existence of pus in the appendages of the uterus, when the most exact examination did not give the least signs. The reaction of pain, or of intolerance, happens in those cases where simple inflammation exists. Handart noted the fact that an intolerance of the constant current exists also in the case of cancer, while it does not exist in fibromata and in metritis, which is easily confounded in a clinical way with cancer.

Dr. Boisjean du Kocher calls attention to another diagnostic value of the constant current. Treating, as he communicated at the Congress of Amsterdam, the uterus and its annexes with oxychloride of silver, obtained by electrolysis, he could study the electro-diagnostic action of his method, which allowed him to make a rapid diagnosis of cancerous degenerations of the uterus.

After many investigations Boisjean du Kocher believes he is able to establish the following diagnostic rules:—

The signs, on which he grounds his belief, are the following:—

1. By the persistence of hæmorrhage he determines the absolute uselessness of treatment by the oxychloride of electrolyzed silver.

2. Imperfect formation of the oxychloride of silver, and the incomplete adherences that sometimes occur of the silver sound to the mucosa.

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3. Inertia of the uterine muscle, which does not correspond to the electrical excitation.

Of these three signs, the two former have no value taken separately, but are a presumption; if associated with the third, they have a real value, indicating an absolute certainty in treatment.

Electricity as a Curative Agent.

Having dilated upon these few things in general in order to have a clear idea of the value of the medicinal electric current, you will allow me to relate, as briefly as possible without abusing your kindness, my experience therewith.

If for whatever reason I cannot proceed with a surgical treatment in uterine diseases, I apply electricity, in the form of galvanocaustic after the method of Apostoli. I have used it for almost ten years, and especially in the following cases:—

I. Those of simple hæmorrhage.

II. Those of subinvolution.

III. Those of amenorrhœa.

IV. Those of endometritis and simple or complicated metritis, with lesion of the cervix.

V. Those of fibromata.

We will now call attention to these several points.

I. Simple Hæmorrhages.—I do not know how to tell you, from the anatomico-pathological point of view, what I understand under the name of simple hæmorrhage, because I never had anatomical pieces for examination; but I will call those cases simple hæmorrhage from the clinical point of view: those which happen on subjects who do not present any evident cause, either local or general. These hæmorrhages come from myomatosic knots, from soft endometritis, from subinvolution of the organ, or from simple stasis of the mucosa (?). I could not attempt to explain it. There are, indeed, many women who present more abundant periods than in ordinary cases, and to such a degree as to make them ill. Others have more or less abundant hæmorrhage, even outside their menstrual periods. Another class of persons affected by hæmorrhages, and a class which is larger than one might believe, is made up of girls menstruating for the first time. On this subject I have written in one of my works. These girls may be annoyed by hæmorrhages through every period or only the first time, it seems. In the first

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place, there is almost always a sign of metritis, while, in the second, the hæmorrhage depends usually upon an exaggerated tendency caused by reflex excitation, which depends on the maturation of the ovule and the rupture of Graaf's vesicles. This peculiarity brings a greater afflux of blood to the uterine mucosa, which is in a state of development, and not yet enough resistant, and beginning for the first time its function. This pathogenic concept is clear, if we think about the mechanism of the menstrual flux.

In all these cases I obtained splendid results through the electric current. In many cases a few applications of positive intra-uterine current, lasting five minutes and of an average strength of 80 milliampères, are sufficient to prevent hæmorrhage from returning and to bring normal regularity to the periods. In some cases several applications were necessary, while in others electricity was not good, but increased even the loss. In some of these cases I was obliged to perform dilatation and evacuation of the cavity.

I have treated about 150 women with the positive intra-uterine pole; 70 per cent. of them at last recovered entirely, 20 per cent. had amelioration, and in 10 per cent. the hæmorrhage was not arrested, perhaps because they were cases of malignant lesions the existence of which could not be exactly determined.

II. Uterine Subinvolution. — Where electricity has very marked success is in cases of uterine subinvolution not only in the post-partum, but in the post-menstrual condition also. Let me now explain my method. It is generally known that the tissue of the uterus increases during pregnancy, depending upon hyperplasia as well as upon hypertrophy of its muscular elements, and we know, too, how the uterus after child-bed is gradually reduced through the retrogression of the superfluous elements. This reduction is called involution. But we see now that this progressive reduction is disturbed,—whether through a sequence of circumstances or through infection is not quite clear to me,—and that the uterus remains swollen, heavy, and congested, which causes often flexions, and the patient has not only mechanical disturbances by the misplacement of the organ, but also prolonged menstruation, hæmorrhage, and metritis. We all agree on this point.

There is another subinvolution which has not been considered till now, but it must be considered in the etiology and pathogenesis of the diseases of the uterus, and which follows the irregular menstruation, and that I call menstrual subinvolution. I will explain it.

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When the period approaches, the uterus, and especially the mucous membrane, increases in volume by the neoformation of the blood-vessels, and by the greater afflux of blood. After the anatomical concept of Reiffer, which he showed lately at Amsterdam, he found a real emigration of blood-corpuscles whose existence is due, he says, to the venous blood-vessels, which do not undergo any rupture. Consequently one would, in this tissue, have a kind of non-inflammatory exudate. This is not metritis in its true sense, but it is a physiological state, which becomes pathological when the regressive evolution is interrupted. But we have here a sequence of circumstances, which determines a certain degree of swelling of the organ, which could alter the physiological function of the uterus during menstruation. If such disturbances repeat themselves, one finds a real alteration, which constitutes that kind of condition called menstrual subinvolution.

The causes of this subinvolution are those circumstances which interrupt the regular course of the periods, and especially sexual relations, at a time when the menstrual process is approaching, or during or immediately after the periods.

To this anatomical condition belongs that peculiar state we meet so often in young married people, in whom the power of youth determines the abuse of sexual relation, without any precaution, which produces in the young women leucorrhœa, abundant menstruation, and real hæmorrhage, even endometritis. These cases are of great frequency in prostitutes, and one understands why.

In all these cases of recent subinvolution, the electric current does very well and exercises its whole beneficial, curative, and prophylactic power: curable, by allowing subinvolution to disappear and prophylactic by suppressing the cause of flexions and metritis.

III. AMENORRHŒA.—If there is a specific remedy for a disease or an existent infirmity, it will certainly be the electric current in the treatment of amenorrhœa. The electrical treatment for amenorrhœa is not quite new. It has been known since the last century, and the first applications are attributed to de Haven, who employed it in 1755 for the cure of amenorrhœa. Even Alberti, publishing, in 1764, a work about the treatment of amenorrhœa by the electric current, described its excellent results and established the fact that amenorrhœa was the first gynæcological disease cured with electricity. Since 1869 electricity has been employed here and there, and with happy result in menstrual troubles.

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The ancients were more preoccupied with the treatment of amenorrhœa than we are, because they considered it to be a serious trouble, believing that the woman's blood, increasing in quantity and overloaded with noxious principles, would cause serious consequences to the organism if Nature did not provide against it by the periodical loss of a certain quantity of blood, or if the organism had not been purged, as they called it, by menstrual flux. This shows clearly how solicitous they were for the treatment and disappearance of amenorrhœa. Later on, when physiology showed us the phenomenon of involution and the mechanism of menstruation, less importance was given to amenorrhœa, it being considered to be produced by the accidental effect of a certain degree of blood-stasis within the uterus.

I wish to say, on this point, that this conception of things is not perfectly correct, for I believe that, through the periods, the organism is freed from a certain quantity of material which would be dangerous while retained, causing obesity, chlorosis, anæmia, etc. I wrote a paper on this subject some time in 1894, reading it at the International Congress at Rome, and I have since then noted how the idea was prevailing that chlorosis was the effect, rather than the cause, of amenorrhœa.

Consequently menstruation will be considered, not as an accidental hæmorrhage or as an effect of uterine stagnation, but as a true course, through which are eliminated all dangerous materials. Therefore the logical and reasonable conclusion that amenorrhœa constitutes a serious disturbance and a serious morbid state. This explains why everybody knows the importance and necessity of curing amenorrhœa.

Amenorrhœa is the suppression of the monthly flux. Putting aside the menopause, fecundation, the obliteration or removal of the genital channel, castration, and long and chronic constitutional diseases, we have three causes for amenorrhœa: The evacuation of the uterine cavity, post-partum superinvolution, and an organic cause, so to speak, idiopathic with any important lesion or other causes, which can happen in healthy and strong women.

In these three illustrations of amenorrhœa, for which famous emmenagogues have had their sway, the electric current has an excellent therapeutic action, bringing with its application a complete and rapid recovery. A number of cases of amenorrhœa have been reported cured by electricity, and forming a statistic series. Besides

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the ancient ones, there are some belonging to Nitot, Labbé, Massin, etc. In Italy, Candia, of Naples; Schiavoni, of Rome; and myself have published works on this subject. What the action of electricity in the treatment of amenorrhœa is, is not yet demonstrated. It is claimed that the negative pole would be congestive, while the positive would have an hæmostatic action. On this point is settled the theories explaining, through an especial mechanism, the action of the current which comes from the negative pole placed within the uterine cavity.

Massin believes in the probability that the better effects of faradization followed by galvanism reside in the vasomotors of the uterus and in the reflexes which, at the same time, while they produce muscular contraction caused by the current, effect a development of the uterine tissues, thus improving their nutrition.

The negative pole is considered as a cause of hyperæmia, and it is for the purpose of establishing an afflux of blood into the uterus and to support it with ulterior applications that we employ the negative intra-uterine pole in the treatment of amenorrhœa.

Tripier, whose authority in this matter is beyond discussion, does not like this explanation, nor others of the same class. He dislikes also the term electrolytic: First, because one obtains rather a chemical caustic action rather than an electrolytic action, through the application of the electrode with a current of 40 to 50 milliampères lasting, each, five minutes. Second, all electrical procedures have been used in amenorrhœa. Franklinization was much valued in the last century, while uterine faradization or simply the lumbo-superpubic application gave good results to Duchenne and to some others. On this account Tripier does not understand why the negative pole alone is useful. To attribute the beneficial influence of the negative pole to the fact that it has a congestive power, while the positive pole is hæmostatic, is not quite exact, being the effect of popular prejudice, based on a forced interpretation of an observation of Remak, who says that the negative pole is hæmorrhagic. This is an error, indeed, because both the poles are hæmostatic, when applied with sufficient dosage. Consequently one does not know precisely the electrical action, and which pole is to be introduced into the uterine cavity.

Whatever it may be, if the mechanism of the action of electric currents are not clearly known, we have nevertheless a reviving of the organic power of the lulled ovaries; a fortification and better

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development of the uterine tissue, with greater afflux of blood into the mucosa; so that the menstrual disturbances cease. In every case the clinico-empirical fact exists, and, even if scientific explanations are wanting, there is no reason for not using the therapeutic effect by which a rapid and complete recovery is obtained. Indeed, in all of the observations which I have been able to collect, including my own cases, it is clearly shown that *séances* of a current of 40 to 50 milliampères are sufficient to restore the normal, sanguinolent course in menstruation which, before its use, was habitually irregular in time and quantity.

IV. Endometritis and Simple Metritis with Laceration of the Cervix.—I do not put here the question if we ought to admit a simple inflammation of the endometrium without any participation therein of the muscular tissue of the uterus, or to settle if it is correct to say metritis when one means also some other alteration of the mucosa. One could assert it from an anatomical point of view, but from the clinical aspect, as I believe, it would be logical to entertain a difference between endometritis and metritis, because they have different symptomatic peculiarities. One ought also to admit a difference in clinical expression between endometritis and metritis of the cervix and of the body of the uterus, although knowing there is no marked anatomical limitations between inflammations of the cervix and of the body.

Yet, electricity is considered as a powerful remedy in the treatment of endometritis and chronic metritis, in so far as to satisfy completely the three indications therein: etiological, symptomatic, and anatomical.

From the etiological point of view we have seen that the affections of the uterus are chiefly due to its infection through the gonococcus, consequently the electric current will not only destroy the infective power of the germ, but will increase the phagocytic power of the elements so as to be able to fight powerfully against the cause.

From the symptomatic point of view electrical treatment causes leucorrhœa entirely to disappear, as well as hæmorrhage, while it also relieves pain.

From the anatomical point of view, besides inflammatory conditions, there exists an anatomical and pathological alteration of subinvolution in metritis and endometritis. But very often we find a real triumph over these alterations by using electricity, especially if there is hyperplasia and hypertrophy of muscular elements, though

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there will not be the same success if we find atrophy in those elements and hyperplasia of the adjoining tissues. Here the uterus is atrophied by natural ways, like a cicatrized tissue, and electricity can be of no use at all.

Electricity achieves a real triumph, not only in simple metritis, but also in that kind which is complicated by laceration of the cervix, the latter forming the very El Dorado of microbes, from which they depart, invading the uterus and its appendages, as I showed in one of my writings. I examined several cervices having deep laceration on one side and others with laceration on both sides, complicated with extroflexion of the ulcerated mucosa, from which inflamed strings of lymphatics spread themselves laterally on the large ligaments. In some of these cases of metritis with laceration of the cervix and salpingitis medical treatment was of no avail, producing no curative results; so that some surgeons thought of performing hysterectomy for chronic metritis. They concluded that the secondary condition would justify hysterectomy. Nevertheless I obtained a recovery by applying the electric current to women so affected, and I saw even how ectropion disappeared with complete normal reduction of the cervix, in those cases where I formerly would have thought amputation of the cervix, trachelorrhaphy of Emmet, or extirpation of the uterus needful.

It is for this reason that I will attempt to give some explanation concerning amputation of the cervix following pregnancy and miscarriage. Pinard, basing his opinion upon facts, which are neither numerous nor well defined, protested against amputation of the cervix as causing deformities of the organ, miscarriage, early childbirths, and dystociæ. I would not deny that a poor amputation of the cervix and its faulty treatment produced cicatrices, and thus hinder the physiological process of delivery; but it seems to me an interruption of pregnancy would not be a logical result of it. In every case, the greatest number of authors affirmed through their own experience that each operation practiced after Schröder's method, or after that of Simons, causes, if properly made, union by first intention; so that it would be difficult to find any deformed cicatrix, especially after the modifications I employed in amputation and suture.

However, Pinard's alarm is an argument not to operate lightly on the cervix. The crucial operation will be made when it is indicated, and even at its best condition it shows one more reason for

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curing metritis through electricity. But there is a serious disadvantage to be noted, and that is the length of time required for the treatment of metritis cured by electricity. It is rather long, the patients are tired and often stop it or give it up before recovery is established; so that results are not so brilliant as when they are cured surgically, through amputation of the cervix and evacuation. But, on the other hand, the effects of surgery are less durable, because, through surgical treatment, recoveries are not sure, and thus frequent relapses occur.

To summarize: I think I can say that I obtained 60 per cent. of recoveries in 250 cases of metritis and endometritis, all cured with electricity, some of which good results are many years old. I obtained 20 per cent. of amelioration, and none at all or very little results in the other 20 per cent. In several cases my patients completed the treatment by taking mineral waters and sea-baths. The 20 per cent. of my patients, as I know, became pregnant afterward, having been sterile for many years.

V. FIBROMYOMATA.—We come now to the great question of electrical action in the treatment of uterine fibroids. Is it beneficial, harmful, or indifferent? Such are the questions physicians wish to be answered. After all that has been written and said on this matter for years past, after the utterance of "hosanna" and "crucify" concerning the electric current in the treatment of neoplasms, it seems to be rather superfluous to speak any more of it; but we do it with the intention of putting an end to the equivocal ideas of most people. The error consists in having meant to obtain more cures than can be possible in the treatment of uterine fibromata through electricity.

And now the explanation: When Apostoli applied strong currents through his method, he thought, with Cutter, Kimball, Emboni, Ciniselli, and Cheron, who had seen small fibromata disappear through the electrical puncture of long needles driven into the tumor or with electrical tampons placed within the vagina—that electricity brought such great modifications in the anatomical constitution of the neoplasm as to cause the tumor to disappear. In those moments of trial they had the right to have the greatest hope. This was the first aim of the electrical cure in fibromata. Later on they perceived that atrophy of the tumor was not produced, but that the electric current stopped frequently the principal symptom, hæmorrhage, which constitutes the gravest condition. Consequently they

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came to the determination to use electricity in the symptomatic cure.

By treating a uterine fibroid with electrical energy we ought to apply it when hæmorrhages present themselves, when we can stop them, but without the avowed intention of causing them to disappear themselves. This is Apostoli's chief question. We spoke of it but in vain! It is a pity to witness some surgeons and professors of clinics who do not even discuss the use of electricity in uterine fibromata because sometimes it has not cured the morbid process, and because the tumor has not always disappeared. Allow me, gentlemen, to declare that this accusation is simply ridiculous, since it is not only significant of ill-will, but even of ignorance. So, then, we ought to settle the chief point of the question at issue in declaring that electricity affords a powerful symptomatic remedy in the treatment of uterine fibromyomata, and yet we ought not to intend it for a radical cure, which will only be obtained by the knife. This is clear, and thus we are in the line of truth. Last year I spoke extensively of the question in one of my studies regarding uterine fibroids from their different points of view; consequently I will not further continue this subject, having a limited space. But I can assure you that the neoplasm is not of bad nature and will only become so in exceptional cases. It will seldom be dangerous, save by constitutional alteration and hæmorrhages.

Hæmorrhagic fibromata and submucous tumors are not frequent, and in the greatest number of cases we can arrest hæmorrhage and reduce the tumor to an inactive and harmless condition. It is a common opinion of great gynæcologists that fibromata should not be touched except when they are troublesome. This was maintained by Martin, Olshausen, and others in the last German meeting of gynæcologists. It was also affirmed by Shauta, Doyen, and most of the speakers who took part in the discussion at the Congress of Amsterdam. It was also the opinion of Ricard, who discussed hysterectomy at the Surgical Congress of Paris, and I also sustain it for the past ten years at least.

If the uterine fibroid begins to be tedious, it will be necessary to begin with the removal of the tumor by the vaginal or by the abdominal way, not only in those cases in which the neoplasm is in the cavity, peduncular or subserous, but also when it is interstitial through Cæsarean operation, as Mangiagalli and Ricard practiced, and as I shall do in a case on which I intend to operate very soon.

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Hysterectomy—that is, removal of the myomatous uterus—can only be practiced in a few cases of necessity, and with precise indications.

Indeed, do not trust those surgeons who remove the uterus whatever the size, the number, or position of the tumor, or the age and social condition and interests of the patient. Do not believe it could become a malignant tumor or kill the patient without an exact and special reason. Fanaticism for major surgery may be excellent, but not always justifiable. The desire to obtain statistics or pecuniary interests tend to exaggerate ordinary opinions. I beg your pardon, gentlemen, if I speak too openly.

I will say that the electric current is excellent in the symptomatic cure, and often the only one adapted in uterine fibroids. I am pleased to give here the results I obtained on more than a hundred cases, which agree with those of Apostoli's large practice:—

1. I obtained 60 or 70 per cent. of diminutions, arrest of hæmorrhage, and at the last regulation of the menstruation.

2. In 40 to 50 per cent. regression or disappearance of the peri-uterine exudations.

3. In 50 to 60 per cent. repression or diminution of pain.

4. In 10 to 15 per cent. partial, but not constant, regression of the neoplasm.

5. In 60 to 70 per cent. I obtained general amelioration, direct action on nutrition, and indirect on local amelioration.

Electrotherapy in the treatment of fibromyomata of the uterus, being palliative or symptomatic and without any pretension to being an absolute and radical cure, can, nevertheless, give a lasting benefit, if performed for a sufficient time and in a scientific manner, and it cannot be considered as an empirical practice, but more as a method basing itself on general physiology and pathology. Consequently this rational cure is the best for uterine fibroids, having the advantage, too, of restoring the patient, and of giving her the benefit she ought to have, even without removing the organ itself, which generally causes personal dangers and annoyances to the family and to society. In cases where electricity is fruitless, the patient will always have the advantage of surgical intervention, which the former treatment will not exclude when employed in a justifiable and legitimate manner.

In conclusion, I have tried to bring before you my knowledge of this interesting subject, and I desire to say a few words more: I do not mean to claim that uterine electrotherapy ought to be a

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rival to or to supplant a surgical cure, which has been and will always be of the greatest benefit, but I desire to impress upon the profession the value and utility of the electric current in uterine diseases as a therapeutic and conservative agent. And we must remember, also, that, after having scattered the most savage denunciation on this field, surgery aims now at this conservative therapy which I have defended fervently for ten years.

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THE GENERAL OFFICE-WORK OF A GYNÆCOLOGIST.

By F. D. Morse, M.D., Melrose, Mass.

The physician of to-day who devotes his time to an office specialty is necessarily obliged to have a more complete armamentarium than his predecessors.

Electricity is used to more or less advantage by specialists on the eye, ear, throat, nose, and nervous diseases; but nowhere has it a greater range for alleviating symptoms and curing diseases than in gynæcology.

The physician who is timid and hesitating in his gynæcological work, allowing his patients no further benefit than may be derived from tamponade and vaginal injections, also the use, or rather abuse, of pessaries, finds in the appreciation and proper use of electricity a means of enlarging his sphere of usefulness.

On the other hand, the doctor who can see nothing but surgery for pelvic adhesions, exudations, or sore ovaries could, if he only would, save much suffering and surgery by the intelligent use of electricity.

Unfortunately the latter class of physicians will not avail themselves of the opportunity of receiving the necessary instruction on the subject, and when they do apply this mode of treatment it is too often with cheap appliances: a selection which is in keeping with their lack of faith in anything but their original surgical teaching. As a natural consequence, they have uncertain and variable results; and hence this valuable means of enlarging their office-work and benefiting a greater number finds its way to the attic, there to repose indefinitely.

By the intelligent use of electricity we have an agent which regulates the circulation of the whole pelvic cavity, stimulates functional activity, controls hæmorrhages, corrects nutritional faults, relieves pain, and may cause retrogression of benign growths. It is invaluable in making a diagnosis where a possibility exists of a deep-seated pus-formation. Scientifically applied, it is absolutely without danger.

The conditions and diseases which are most frequently to be met with in our office-work are found in cases of active inflammation, as in metritis, endometritis, non-suppurative salpingitis, chronic ovaritis, and periuterine inflammations.

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A second class may be considered as of the non-inflammatory variety, which includes uterine fibroids, except the subperitoneal kind; subinvolution, hypertrophy of the uterus, displacements, ovarian neuralgia, and disorders of menstruation.

Still a third class may be styled examples of a post-inflammatory condition, as is found in periuterine exudations, adhesions, flexions of the uterus, stenosis of the cervical canal, and erosions of the cervix, and there are also reflex neuroses which are more or less amenable to electrical treatment.

It is not the object of this paper to discuss the physiological action of the currents used in individual cases, or to describe the technique under the various conditions: questions that have been ably dwelt upon before this society several times, though ever in the discussions new and valuable suggestions are added.

The general practitioner of to-day who reads the literature on the subject, and especially the recent graduate, is quite expert in treating the diseases of women, compared with the older members of the profession who have not kept pace with the newer ideas. Therefore the progressive physician with a proper electrical outfit, and after acquiring an intelligent use of the same, is in a position to retain and benefit a larger proportion of cases which would otherwise go to a specialist or possibly to a "quack."

The application of electricity to the uterus and its appendages requires a greater nicety of manipulation than is generally accredited to it. For instance, in any acute inflammatory state it is not contra-indicated, but to make it tolerant to the patient one must observe a more strict attention to detail, according to the case, for at different periods the same person may demand a different dose for the same disease. As the dose can be measured to a nicety, the intensity of the current, the size of the electrode, and the length of the application are the important factors.

If the *séances* be too long or too frequent, repeated congestion may be set up, together with the consequences which follow, such as inflammation of mucous surfaces. On the other hand, undue timidity fails to get the therapeutic results, and, when the disease returns because of this factor, the method is likely to be condemned instead of the operator.

Nearly all of the cases mentioned may be treated in our offices, allowing the patient to return home at once by street-car or carriage. When galvanic currents exceeding 75 and 100 milliampères are used,

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I think it is best to have the patient remain quiet, and perhaps in a recumbent position, for an hour before leaving the office.

Of course, in all treatments where the puncture method is used the same care, antiseptic and otherwise, must be observed as in vaginal surgery; hence such cases are for hospitals and sanitariums.

As to apparatus, assuming that one has a good galvanic switch-board with a sufficient number of cells, a reliable milliampèremeter, and a high-tension faradic coil, he has all that is absolutely essential to obtain satisfactory results in the class of cases mentioned. The electrodes, especially the intra-uterine ones, should receive the most careful antiseptic care. The external electrodes should be carefully made of either clay, punk, paper-pulp, or asbestos cloth. The latter I have been using for the past year, and, as a rule, prefer it. It is very absorbent, light, easily kept clean, and always retains its shape. External electrodes are usually used too small.

If there is any benefit in the interpolar action in improving the general nutrition, why not give it the greatest possible advantage?

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NERVOUS DISEASES PECULIAR TO WOMEN.

By G. Betton Massey, M.D., Philadelphia.

The subject assigned to me in this symposium is the nervous affections of women. I must admit that my preference in actual practice is to be called on to attend cases in which the pathological indications point to organic pelvic diseases, as it is in this class that I have been able to confirm and add to the claims of Apostoli for electricity as a speedy and sure remedy. To one who has been mainly interested in the therapeutic value of electricity in strictly neurological cases of both sexes, a transference of practical work to the diseases of women is like an emergence from twilight into the bright light of day.

The fact that I belonged to these twilight workers during a number of my earlier professional years has, nevertheless, been of great service in my gynæcological practice, for the border-land between gynæcology and neurology is most extensive, and at times most confusing. The trained ability to discriminate between the purely-nervous and the purely-gynæcological cases is more important to the average gynæcologist than the training in major surgery, which is so prevalent at present and which leads unconsciously to many unnecessary operations. Particularly is this so of the diagnostic acumen and conscience in dealing with these border-land cases, where some form of neurosis is associated with a pelvic congestion, catarrh, or inflammation. When a physician tells me, for instance, that he performs the operation of dilatation frequently, I am certain that the neural side of his diagnostic vision is imperfect, and that his patients are in danger of suffering therefrom.

The true gynæcologist, in fact, should not only be something of a neurologist, but he should also be conscious that his daily work involves questions intimately connected with the specialty known, for want of a better name, as internal medicine. Many women suffering from definite diseases of the organs within the abdomen are under the impression that the pelvic organs are at fault, and thus drift into gynæcological hands. But an even more important consideration is the fact that many of the neuroses, with or without pelvic symptoms, are now properly regarded as general infections, the symptoms being the result of repeated recrudescences and auto-

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infections made possible by a persistent defect in the secretions of the abdominal organs.

It is of the treatment of this latter class, the neuroses of abdominal origin, that I wish to speak briefly. These affections, varying greatly in symptoms in accordance with the susceptibilities of various portions of the general nervous system to the deleterious effects of the poisons that are generated by imperfect organic actions within the abdomen, are commonly known as neurasthenia, or nervous prostration. In clinical practice they should be carefully differentiated from hysteria, as a successful treatment will differ greatly in many respects. This differential diagnosis will not be considered at present, being entirely beyond the limits of this paper. In some cases the differential diagnosis cannot, in fact, be made, for both affections will at times co-exist, demanding a conjoint association of the proper remedial procedures.

A considerable experience with neurasthenia proper has convinced me that it is an affection of abdominal origin. This is largely conceded by those observers who lay stress upon its arthritic or lithæmic manifestations; yet these well-known relations of neurasthenia are at present being obscured by those neurologists who concentrate their attention on one of its symptoms,—fatigue,—even going so far as to call it a fatigue-neurosis, and tracing its origin to metaphysical concepts of a *neuronic* "tired feeling." Why are these cerebro-spinal *neurons* tired? Is it not true that the subjects of this disease are characterized by a lack of vigorous physical employment? Is the disease found among freight-handlers, stevedores, baggage-porters, iron-workers, miners, or other classes of men or women subjected to the strain of severe and prolonged muscular effort? In a large public clinical experience I have never met with a single instance of true neurasthenia among this class, though several cases of hysteria were seen.

The same may be said of the brain-workers. No healthy man was ever hurt by brain-work, in spite of the wide-spread notion to the contrary. But note the modifying condition: that the man must be healthy not to be hurt by this strain. The weak man, particularly the abdominally-weak man, will be hurt by it. The fatigue-neurosis is consequential, not causal. To the healthy man brain-work is a general stimulus to the whole being, though not so much of a tonic as muscular labor.

The abnormal and easily-induced fatigue of the neurasthenic is

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relative, and not absolute. The amount of work inducing it is always less than that accomplished easily by the healthy. It follows, therefore, that it is but a symptom of an imperfectly-fed and poisoned nervous system.

An equally-natural deduction is that rest has no curative effect in these forms of neurasthenia, being only useful as a palliative during the early stages of the treatment, which should be directed to the abdominal sympathetic system, in an effort to arouse the abdominal organs from their lethargic state. When this has been well inaugurated, work, and not rest, is indicated as an important aid in securing a full tide of health, and maintaining it when secured.

The most useful direct remedies are powerful galvanic and faradic currents to the abdominal sympathetic, stimulating laxatives, and the static charge, positive when an arthritic diathesis is present. Under this vigorous plan of treatment, including, in its later stages, prolonged outings, the patient gains every day rapidly in vigor and health, and is generally free from a tendency to relapse when the ordinary occupations are resumed accompanied by the additional exercise that the physician should prescribe.

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USE OF THE CONTINUOUS CURRENT AND ELECTROLYSIS.

By Robert Newman, M.D., New York,

Consulting Surgeon to Hackensack and Bayonne Hospitals, N. J.; McDonough Memorial Hospital; German Dispensary, West Side, N. Y.; Formerly Prosector to Long Island College Hospital; Corresponding Member of the Gynæcological Society of Boston, etc.

In looking over the bibliography of electricity in gynæcology an abundant evidence of the success of electricity was found in text-books, addresses, and papers by the best-known gynæcologists, in which almost every disease peculiar to women was represented.

The list includes particularly:—

Uterus.—Abrasion of the os uteri, stenosis of the os and uterine canal, endometritis, cervical catarrh, amenorrhœa, dysmenorrhœa, menorrhagia, metrorrhagia, flexions, subinvolution, hyperplasia, fibroid tumors, prolapsus, procidentia, polypi, and carcinoma.

Appendages.—Oöphoritis, cysts, salpingitis, pyosalpinx, hæmato-salpinx, and extra-uterine pregnancy.

Pelvic Peritonæum. — Adhesions, cellulitis, pelvic hæmatoma, and hæmatocele.

Urethra.—Stricture.

Bladder.—Neurosis, papilloma, tumors, and carcinoma.

Rectum.—Stricture.

Vulva.—Growths and cysts.

The successful treatment by the cream of gynæcologists must be a fact, if they tell it themselves and have it recorded in the literature on the subject. Naturally the question arises: Why do the same gentlemen, in a body, by a vote denounce electro-therapeutics as a failure? An investigation for facts and truth may not be pleasant, and it is not our desire to elicit unpleasantness, hence let us cover with professional love all differences. Only one inquiry of the writer may be noted here which gives one of the many reasons. One of the staff of a (special) hospital was asked why they have denounced electricity in gynæcology while there are recorded so many successes.

He answered: "We have an excellent electro-therapeutist on the hospital staff, and cases which were referred to him he often did not cure. On the contrary, we often found adhesions when laparotomy was performed after electric treatment."

The electro-therapeutist in question then was interviewed and

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said: "There is some truth in the former statement. I have cured cases, and always have had success with electro-therapeutics, but some cases are either tedious or incurable. Next, I had no choice in the selection of those patients that were suitable for a successful treatment. Some patients not wanted by the operating staff nor by myself were referred to me, and, *nolens volens*, I had to treat the same, even if I knew they were not cases suitable for a successful treatment by electricity."

The very same thing happens to other electro-therapeutists on the staffs of hospitals. They have to treat unsuitable cases against their wishes, and no protest changes the matter; yet even then they often succeed.

About adhesions our ex-president, Dr. Lapthorn Smith, remarked once in a discussion: "I think it is unjust and unfair for my friend, Dr. Joseph Price, and others, to lay all the blame of adhesions on electricity, when they know as well as I do that these complications are met with in cases which have never been touched with electricity, while, on the contrary, they know that cases which have been treated for a year with electricity were found at the operation to be absolutely free from adhesion."

Injudicious treatment, and particularly too strong a current, may cause adhesions; but for the mistakes of an operator the therapeutic agent cannot be held responsible. Mistakes of doctors and druggists may have killed people, but it never has been known that opium or any other drug has been condemned for it.

The writer has treated successfully with electricity most of the diseases he enumerates above. There were a series of prolapsus-uteri cases in some of which the uterus was outside entirely, and irreducible. The high-tension current cured every case, and it could be seen how the electricity caused contraction, diminishing the size of the organ so that it became reduced and pulled back to its normal place without using even the hand, but solely by the action of the electric current. But let us adhere entirely to our text: the use of the continuous current.

In many cases electrolysis was used, which means that the galvanic current is applied in such a manner that by a chemical decomposition compound bodies, or salts, are reduced to component parts. As a result, the current causes absorption of pathological formations, not alone polar, but interpolar; and this fact explains, also, how we induce absorption of fibroids.

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Fibroid tumors of the uterus may be subperitoneal, interstitial, or submucous. Nobody would advocate the use of electricity in subperitoneal fibroids, and it seems that many operations for them were unnecessary, as we often find at autopsies large peritoneal fibroids, which in life never had troubled the bearer. With the other two varieties the writer has had invariable successes.

Formerly needles were used, partly as galvanopuncture under strong currents. Dr. J. N. Freeman, of Brooklyn, read a paper, January 20, 1885, before the Medical Society of Kings County, in which he reported 3 successful cases of fibroid tumors treated by galvanopuncture. Freeman's needles, somewhat modified by insulation, are here for inspection. Freeman made applications under an anæsthetic with needles and with strong currents. Freeman's memory as a pioneer in this line should go down to posterity. During his life the Brooklyn profession could not comprehend his arduous work and success. Almost at the same time our lamented honorary member, Georges Apostoli, propagated his labors in establishing his method by electricity, labored assiduously in Europe and America, was successful, made many friends, but met also bitter opposition, and was more abused than appreciated.

Ménière, in Paris, with 6 cases, and J. T. Everett, of Clyde, Pa.,[1] with 17 cases, came next, and were followed by Franklin Martin,[2] W. E. Steavenson,[3] E. Cutter,[4] Semeleder,[5] A. H. Buckmaster, W. F. Hutchinson, A. Lapthorn Smith,[6] J. H. Kellogg[7] G. B. Massey, Schavoir, and many others too numerous to mention.

A recent note of value is contained in a discussion on "Fibroids" at the last meeting of the British Medical Association, where our honorary fellow, Dr. Skene Keith, said he believed in, and practiced, Apostoli's method.[8]

The art of applying electrolysis successfully in gynæcology consists in:—

1. Using the correct strength of the galvanic current.

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[1] *New York Medical Journal*, April 18, 1885.
[2] *Journal of the American Medical Association*, April 23, 1887.
[3] *British Medical Journal*, October 1, 1887.
[4] "Transactions of Ninth International Medical Congress."
[5] *Wiener klinische Wochenschrift*, October, 1888.
[6] *Journal of Electro-Therapeutics*, January, 1890.
[7] *Times and Register*, February 7, 1891.
[8] *Medical Record*, August 25, 1900.

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2. In applying the poles at the right place.
3. Selecting the size and material of the electrodes.
4. Timing the duration and intervals of *séances.*

Electrolysis applied with a mild current will cause absorption only, while a strong current will cauterize and even destroy tissues. Therefore the operator must know what effect he wishes to produce, and then accordingly graduate the strength of the current. Very strong currents have been used, but the writer has always advocated weak currents, and has been successful in his cases. This is a practical point in the argument, but his theoretical reasons are that strong currents may cause serious inflammation and destruction of healthy tissues.

The writer has always succeeded better with mild currents, and prefers to use the mild currents a longer time, if necessary. By mild currents is understood a strength which can be tolerated by the patient without being painful. A fixed amount of milliampèrage cannot be stated. Applying the correct pole in the right place means particularly to use the positive pole for stopping hæmorrhages, while the negative pole will absorb the fibroid tissues.

In selecting the material and size of electrode the writer does not use needles, but gradually inserts into the uterus a blunt platinum sound, and always carries it by degrees into the tumor, sometimes to the depth of eight and ten inches. For the abdominal electrode nothing suits better than the potter's clay, which, however, must be kept warm, smooth, and moist; its dimensions are about 12 by 20 inches.

Duration and intervals of *séances* must be regulated according to indications. The time for a cure of a fibroid tumor cannot be exactly stated, but depends on the nature, size of tumor, complications, and the constitution and pluck of the patient.

Interstitial tumors may be either diffused through the walls of the uterus or concentrated in one locality. If concentrated, which is usually the case, the electric current is directed toward the tumor. These tumors are more or less capsulated within the wall of the uterus. The treatment by electrolysis consists in possibly causing absorption of the tumor, or at least in making it smaller, cutting off its nutrition, and leaving it in a dormant state, in which it will do no harm. Sometimes it may be well to rupture the capsule. Then one of two things may happen: the tumor may slough off piecemeal, which takes some time, during which the electric cur-

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rent may do harm by leading to sepsis. Great care must be taken to prevent sepsis in these cases, and to keep up the vitality of the patient. In one case where the tumor was very large and of eleven years' standing, the writer operated in the way just described for over three months, using the blunt platinum electrode. The patient was very weak and often in collapse, but finally made a good recovery. In this case the diagnosis was made by Dr. E. M. Moore, of Rochester. Another patient was brought to the writer's office who had lost so much blood by active hæmorrhage that her life was in danger. She had to remain at my house, for electrical treatment, as she was almost bloodless. She made a good recovery. I heard from her twelve years afterward, at which time she was alive and well.

Sometimes, after the capsule has been ruptured, the tumor may be pulled out of the uterus, as in enucleation, and, if the adhesion is small and pedunculated, the tumor may be removed in its entirety at the pedicle with the galvanocautery écraseur.

Submucous tumors are almost always hanging by a pedicle in the uterine cavity, and give the most trouble from hæmorrhage. The best treatment is the removal of the tumor by the galvanocautery under antiseptic precautions.

The writer has always treated his cases of fibroid tumors successfully by electricity and has never lost a case. Sometimes the tumor did not entirely disappear, but was small and lay dormant, without causing any trouble or inconvenience.

Now, a few words about the diagnosis of his cases, which have always been verified by good authorities, or made before the patient was referred to him. In some cases the writer selected a good honest surgeon of unquestionable standing, who was *understood* to be prejudiced against electricity, to examine the patient, to confirm the diagnosis, and locate the fibroid tumor. The same surgeon was again invited to examine the same patient after the electrical treatment, who then acknowledged that the tumor could not be found any longer, and that therefore the electrolysis must have absorbed it.

Some may ask why these cases have not been published before. My answer is that I have had my share of abuse for praising electrolysis, and therefore would leave some criticism for others; besides, I did not wish to encroach so far on the work and glory of the gynæcologists. Other diseases of the uterus have been treated

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with various results. Is there a man who can assert that he has cured all cases of uterine catarrh by any routine? *Ovarian tumors* cannot be expected to yield under any electric treatment, because they are mostly multilocular cysts, and piercing the needle into the tumor may cause peritonitis and adhesions.

Pelvic cellulitis may be cured by electrolysis by judicious and careful attention. The writer had, among other cases, a very bad one, with adhesions, which held the uterus retroflexed and adherent in the peritoneal cavity. A consulting gynæcologist confirmed the diagnosis and considered the adhesions permanent. The writer treated the case by persistent electrolysis, using the negative pole in Douglas's *cul-de-sac*, pushing the instrument backward and upward. The adhesions were thereby removed and the patient cured. This was eighteen years ago, and the patient was seen only recently, having remained well since that time. Several other similar cases are in the writer's notes, but none with such bad prognosis.

Peritonitis has been cured by Dr. W. E. Ford, of Utica.[1]

In periuterine hæmatocele Apostoli[2] has had excellent results by negative galvanic puncture. He added: "It is applicable alike to hæmatocele, abscess, fibromata, interstitial myomata, and extra-uterine cysts."

Strictures of the female urethra are rare, but they occur occasionally and are readily cured by electrolysis. The writer has reported some of his cases.[3]

Oöphoritis and salpingitis are intimately connected, say our modern authors. Cases appear in different stages; some are very difficult to manage, and no treatment will positively cure.

The writer has had some cures by electrolysis, having notes of cases from 1872 to 1887. One acute case was well in five *séances*. He generally used a negative metal electrode *per vaginam*, and positive pad on abdomen over ovary.

One case in private practice was a patient who was very poor. She was treated medically, and, as it was almost a hopeless case, friends applied for admission to hospitals, and in every institution the surgeon in charge insisted on laparotomy and removal of the uterus and appendages.

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[1] *The Medical Press of Western New York*, April, 1888.

[2] *American Journal of Obstetrics*, April, 1886.

[3] *American Journal of the Medical Sciences*, October, 1875.

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The writer, objecting to such harsh measures, after a morphine dosage, took the patient to a hospital out of town to which he is attached as consulting surgeon. There the patient was curetted, drainage established, and she made a good recovery. Have seen her only very recently. No electricity used.

Bladder, Neurosis; Papilloma, and Tumors.—Electrolysis, after the diagnosis has been made by the cystoscope, is certainly indicated. The writer has removed papillomata with the galvanocautery and tumors by electrolysis with needles. The paper in relation thereto was read before this association at Chicago in 1893.[1]

Strictures of the rectum are more successfully treated by electrolysis than by any other method.

The writer has had considerable experience with cases of stricture of the rectum, and read a paper on this subject at Newport in 1889 before the American Medical Association.[2] Most cases were successful, some could not be expected to get well, and one female underwent a surgical operation in a hospital and died soon afterward.

The *vulva* has sometimes growths or cysts, which can be removed either by surgical operation or by electrolysis.

Extra-uterine Pregnancy.—The profession is divided about the best treatment in extra-uterine pregnancy, and some prefer laparotomy. However, we have the report of successful treatment by electricity of eminent men, of whom the following may be mentioned: Drs. A. D. Rockwell,[3] E. G. Landes,[4] Nathan Bozeman,[5] N. J. Garrigues,[6] William Goodell,[7] Ely Van de Warker,[8] Reeve T. Lusk,[9] A. H. Buckmaster,[10] Mathew Duncan,[11] Percy Boulton,[12] and W. E. Stephenson.[13]

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[1] *Times and Register*, Philadelphia, November 11, 1893.
[2] *Journal of the American Medical Association*, May 17, 1890.
[3] *Medical Record*, February 17, 1883.
[4] *Medical News*, April 8, 1882.
[5] "Transactions of New York State Medical Association," 1884.
[6] "Transactions of American Gynæcologist Society," 1883.
[7] *Union Medical Magazine*, Philadelphia, December, 1888.
[8] "Transactions American Gynæcological Association," volume xii, p. 296.
[9] *American Journal of Obstetrics*, xiv, 329, 1881.
[10] *Medical News*, July 21, 1888.
[11] "St. Bartholomew's Hospital Report," volume xix.
[12] *British Medical Journal*, April 30, 1888.
[13] *British Medical Association*, 1886.

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The *modus operandi* differs, but it seems that electrolysis is mostly used. One method is to have one pole in the vagina or rectum, the other pole above the abdomen, which must be repeated until viability of the ovum has ceased.

From our own experience and from the literature on the subject we are of the opinion that better results are obtained from the treatment by electricity than by other means, and the reluctance of gynæcologists to apply electricity, or at least to recommend it, has not been explained.

We need a means for a better education of the medical man in electro-therapeutics, and should strive to see the establishment in New York of a school, laboratory, hospital, and clinic devoted chiefly to it.

148 West Seventy-third Street, New York.

DISCUSSION ON ELECTRICITY IN GYNÆCOLOGY.

DR. MASSEY expressed the opinion that the subtitle of the discussion, which referred on the program to "the present reluctance of gynæcologists to use electricity," was unfortunate, for it is not true that there is at present a reluctance to use electricity by true gynæcologists. It was a fact, however, that the surgeons who were at the present day masquerading under the name of gynæcologists are reluctant to use electricity. The reason for that reluctance was well set forth in a paper by one who is amply able to give the facts: Dr. A. Lapthorn Smith. This paper was read before the American Medical Association at Baltimore in 1895. In this paper, while apologizing for his own reluctance at reading papers on this subject, Dr. Smith made a statement eulogizing the extreme value of electricity in gynæcology, adding, however, that his own time was so much taken up with surgery that he could not afford to take up the slower, though at times better, work of electricity in gynæcology. He said that his friends in Montreal had advised him to stop reporting successful treatment of gynæcological cases in the local medical societies, as he would lose caste. But he said that fifty or one hundred cases which had been cured would rise up and protest in his mind if he adopted their suggestion. His papers and reports on the successful treatment of gynæcological cases by electricity received but little attention. If he reported a cure of a case in which a small fibroid had been treated by electricity there would be no discussion, in spite of the fact that the woman would be in possession of all of her organs and functions, while if he brought in a bloody specimen there would be ample discussion. This gentleman did not give a reason beyond lack of time for the slower work of electricity; but who can doubt that it is at bottom mere commercialism and love of money. At the meeting of the American Medical Association at Columbus, Ohio, a year ago, Dr. Thaddeus A. Reamy, of Cincinnati, that Nestor of Southwestern surgeons, said that to his knowledge a large number of practitioners in the State of Ohio were keeping their patients

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in their own hands, and in health, both fibroid cases and others, by their skillful use of electricity.

DR. ROBERT REYBURN, of Washington, D. C., said that he had never been a specialist in the use of electricity, though interested in it as a scientific study. He felt sure, however, there was another reason why surgeons did not take hold of the electrical treatment. The reason was that our gynæcologists very commonly were ignorant of the laws of electricity. Some time ago he had been puzzled over a difficult problem in the measurement of the current, and had then sought help not only from medical men, but from electrical engineers, but had received no help from any of them. Undoubtedly the love of money was one reason. He had been in practice many years and had seen many waves of opinion, or fads, in practice. For the past ten years there had existed a murderous fad of operating upon women. He had abandoned abdominal surgery himself very largely because he could not sympathize with the present methods of abdominal surgery. Now that these men had mutilated thousands of women they had suddenly come to the conclusion that all this work had been unnecessary. The speaker said he had told one of them of the story of the man at Donnebrook Fair who said that when he saw a head his first inclination was to hit it, and that it seemed to him that the same was true of many surgeons: when they saw a diseased ovary, they wanted to take it out. In his opinion, we were doing a good thing when we adopted any method of treatment that would save our women from the surgical mutilation of the present day.

DR. WILLIAM J. MORTON, of New York City, said, with regard to Dr. Massey's remarks on neurasthenia, that he felt disposed to agree with him on the whole, though perhaps not entirely regarding the theory as to the causation of neurasthenia. As to the question of treatment, he agreed that the electrical treatment was the best. He had tried the rest-cure very thoroughly, but did not think highly of it. He had had patients under observation undergoing the rest-cure for months at a time, with unsatisfactory results. At the present day be treated his cases of neurasthenia by static electricity and by general regulation of their habits, taking special pains to secure sleep, and remove their anxieties, etc. Recently, he had made use chiefly of the wave-current, which he would describe more particularly at the afternoon session. Dr. Newman had brought up the time-worn and rather sore subject of the treatment of the diseases of women, and particularly of fibroid tumors, by electricity. It was extremely unfortunate that the human race seemed called upon to divide itself so often into two camps and have a fight. In these days we should be charitable enough to select the good from all methods, and treat cases sometimes by electricity and sometimes by the knife. This was his own practice, some cases being sent to the surgeon, while others he treated himself by electricity. It was hopeful, in this connection, to note that the gynæcologists were willing to admit that they had sometimes used the knife too freely, and he believed it was time for the electro-therapeutists to admit that they had sometimes adhered too fondly to their favorite method, and had refrained from the use of the knife. Cases of fibroid tumors were very delusive, as they sometimes get well without treatment. A typical case was referred to. It had been reported one year ago. A woman of fifty, whose menopause had occurred, and

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therefore no good effect on the tumor could be attributed to the cessation of menstruation, had come to him with a fibroid tumor about the size of a pregnancy of six or seven months. Several surgeons had agreed on the diagnosis of fibroid tumor; but, as this woman's sister had died under a surgical operation for a similar tumor, she positively refused to submit to the removal of the tumor by the knife. Dr. Morton said that he had agreed to make a trial of the new wave-current, and this had been done for five months. The patient, at the time of beginning treatment, was already exhausted by frequent and profuse hæmorrhages, and had been compelled to give up a lucrative business and take to her bed. At the end of four or five months of treatment with the wave-current the tumor had been reduced in size more than two-thirds. The hæmorrhages ceased about the third or fourth week. The result was also a complete symptomatic cure. She had now gone back to business, and when seen yesterday stated that she felt perfectly well, and that the tumor could be felt, but was quite small. He would refer this patient again to Dr. Grandin, who had made the examinations and measurements before the electrical treatment had been instituted. The case was presented to emphasize the fact that there is more than one way of treating these cases by electricity. The one mentioned had been treated very pleasantly, as well as successfully, with this new current. He hoped others would try this method.

Dr. Lucy Hall-Brown, of Brooklyn, N. Y., said with regard to the use of electricity by gynæcologists, that it was easy to understand why a method of this kind was not popular. One reason was the large amount of apparatus needed, the number of attendants required, and the trouble necessary for the proper carrying out of such treatment. On the other hand, she could not see how any gynæcologist could be really conscientious in his work who does not, with some of his cases at least, employ electricity. Two cases were briefly reported in illustration. One was the case of a lady, about thirty-eight years of age, who had come to her with that yellow pallor so characteristic of a fibroid tumor. It was the size of a large fœtal head, and was intramural. The cervix was so locked that it was absolutely impossible to pass a sound or other instrument. She sought advice because of severe lumbar pain. She was sent to a reliable operating gynæcologist, who, of course, advised operation. The patient had absolutely refused this, and had returned for electrical treatment. This had been carried out by means of the electrical douche, as the tendency to inflammation in this case led her to refrain from using the method of puncture. A very large punk abdominal electrode was used, and with a current running from 50 to 75 milliampères the douche was given. After the first few treatments the current was reversed, using it for five minutes alternately in one or the other directions. The patient was treated regularly for six months, with the result that the symptoms had been entirely controlled and the tumor made smaller. She had not been seen during the summer, but had returned for a few more treatments in the fall, and had left feeling entirely well. This was three years ago. When seen again quite recently the tumor was certainly not more than two-thirds its former size. The woman stated that she had had a little pain in the old location. One treatment was given two weeks ago, and nothing more had been required since that time.

The other case reported was that of a young woman who had a large,

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irritable, and prolapsed ovary. There were some slight adhesions and a tremendous amount of pelvic tenderness. She had also been seen by this same gynæcologist. He did not think this case was one for operation, and expressed the opinion that the electrical douche would probably give the most relief. This treatment had certainly given most decided relief. She had been married eight years, and had been pregnant but once, and this had terminated in a miscarriage. She had been given the douche treatment fifteen or twenty times. This treatment had been followed by a pregnancy which had terminated most satisfactorily.

DR. ALFRED T. LIVINGSTON, of Jamestown, N. Y., said, in support of Dr. Massey's theory about the relation of abdominal states to neurasthenia, that he desired to relate the following case: An active businessman had come to him from the far West in an exceedingly nervous state. A few months previously he had sustained a shock to his nervous system in the death of his sister. Among his other symptoms was a difficulty in breathing from passive congestion of his lungs. This had led him to fear that he was developing phthisis, and would die as his sister had done. In answer to questions the man stated that his bowels were moving regularly and properly; but further observation showed there really existed a constipated state, which had probably lasted for months, if not years. He was treated for two months and a half, beginning with applications of the galvanic current two or three times daily, and it was only at the end of this time that the last evidence of his chronic constipation had disappeared. After the first week's treatment the man had become comparatively calm, being assured that he would recover. He had been well since the cessation of the treatment, about three years ago. He was treated by large galvanic currents, given through the abdomen and long continued. The speaker said that the effect of these currents on the alimentary canal he believed to be responsible for the prompt recovery from the neurasthenia.

Another patient had come under his care about the same time after an operation in New York City by an eminent gynæcologist. Her right ovary had been removed at this operation. Some months later this woman imagined that she detected an enlargement in the left ovarian region. This suspicion he had been unable to confirm by his examinations. The woman, however, returned to New York City and was examined by the same specialist who had operated upon her before. Both this specialist and his assistant claimed that they found a cyst as large as an orange. They advised immediate operation, but the woman, being very reluctant to be completely unsexed, returned to the speaker in a state of nervous prostration. Inquiry showed that the examination made by the specialist had been solely digital, not even bimanual. She was assured that such an examination was insufficient reason for such a diagnosis. She then, with Dr. Livingston, went to the late Dr. Goodell and was examined without the latter knowing the history. Dr. Goodell stated that there was a slight enlargement and tenderness about the left ovary and tube, and insisted that the woman was only neurasthenic. The case was cited as showing the carelessness of the diagnosis of the first specialist, and the lightness with which grave operations are decided upon and urged. The woman had never recovered fully from the shock of what this physician told her. He had learned since that at the first operation the ovary removed had had on its surface only a

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few minute cysts. He felt that this was a striking example of unnecessary laparotomy.

DR. C. O. FILES, of Portland, Maine, said that some years ago he had been invited to be present at a laparotomy in New York City. He had accepted the invitation, and after the removal of the ovaries had asked what was the trouble with the ovaries. The surgeon replied, with a smile, that there had been some irritable condition about the ovaries; but, to tell the truth, the husband had sworn if she became pregnant again he would murder her, and consequently the woman had begged him to remove the ovaries. Many cases were undoubtedly diagnosed as fibroids which did not really require any treatment. For instance, he had been consulted by a woman, sixty years of age, who had a tumor that had been diagnosed by several physicians in New York and Boston as a fibroid. There certainly was abdominal enlargement sufficient to account for the condition of pregnancy at full term. He had treated her electrically by a very simple method for about six weeks, and at the end of this time the abdomen had returned to a nearly normal condition, and the woman went on for years without any trouble. This result seemed to indicate that the original diagnosis must have been erroneous. The case had suggested to him that similar errors might often be made by others.

DR. ROBERT NEWMAN said that he was entirely responsible for the title of the present discussion, and he had given reasons for the same. When gynæcologists in their own meetings declare and vote that they will not use electricity, he thought he was justified in giving the title as it appeared on the program. In his paper he had quoted what Dr. A. Lapthorn Smith had said. With the exception of Dr. Massey, there was no longer any gynæcologist to be counted among the members of this association. He made these statements in defense of the form given to the title of this discussion.

DR. MASSEY said he knew that those who called themselves gynæcologists were neglecting their duty in this direction, but he wished those present to bear witness that these men would be discredited by their successors at no distant date. Perhaps it was inadvisable to be persistent in advocating truth; yet recent international relations showed the necessity for standing up for the truth and for one's convictions, even at the risk of doing harm at times. War was said to be unnecessary by Henry Ward Beecher a little while before six of the greatest wars of the century occurred. When the "Boxers" right here in New York were doing more harm in their offices and hospitals than those in China, it behooved us to oppose them.

His own paper had been largely directed toward a notion prevailing in Philadelphia that neurasthenia can be best treated by the rest-cure. What was known as the "rest-cure" was something else under that name; it was really a rigid mental and physical treatment. The unnecessary removal by operation of fibroid tumors still continues in spite of the fact that he, along with others, could point to 16 per cent. of disappearances, and 69 per cent. of symptomatic cures by electricity, while the remainder were not harmed by it. One of the most unfortunate things about the electrical treatment of fibroids by specialists was that, owing to the time required, most of these sufferers could not afford

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to be treated in this way unless their home physicians became skillful in the work.

DR. S. FAIRWEATHER WILSON, of Montreal, said that he had been deeply interested in this discussion, because in the past he had been guilty of doing a good deal of operating. In the city of Montreal the people were educated to the free use of the knife. Thus, a woman had recently come to him and he had given her the choice between an operation and electrical treatment, frankly stating that he believed the latter would suffice. The patient had promptly elected operation. During the last ten years he had been using electricity more or less. About eighteen months ago a young lady with appendicitis had come to him. One month later she had what he had diagnosed as hysterical convulsions. Every month after this, after the menstrual period, these convulsions had recurred. She had never had them before the attack of appendicitis. His theory was that the appendicitis had caused adhesions around the tube or ovary, and these had led to the attacks of hysteria. He had accordingly advised either an abdominal operation for the breaking down of the adhesions, or the use of electricity, stating that the latter would probably take three months. The first month after beginning the electrical treatment the convulsions had returned, but after the third month there had been no return of the convulsions: now a period of twelve or fifteen months. In the charity hospitals the patients are not disposed to elect electrical treatment, because of its tediousness and the expense incurred. The people are educated to operations, and consequently the smaller hospitals are not provided with the necessary electrical apparatus.

DR. R. J. NUNN, of Savannah, Ga., said that there could be no doubt that selfishness was at the bottom of this question. Some years ago a patient with metritis had been sent to him. This metritis was rather peculiar in that the uterus was nodulated, although there was no cancer present. The nodulation was due to fibroid degeneration. About eleven years before another physician had treated her for a fibroid of one ovary. She came north in the hot season, and while there had seen one of the prominent gynæcologists there. This gynæcologist wrote to the husband stating that if the ovary were not removed she would be a lunatic in three months. The husband was naturally very indignant. Dr. Nunn went with her to the office of the gynæcologist and asked him why he desired to remove the ovary. He said because it was enlarged. The disease of the ovary had been stayed by electrical treatment eleven years before, and had given no further trouble; but the specialist, finding this mass, had insisted upon an operation. Dr. Nunn then told the specialist the previous history as just stated, adding that even his recent electrical treatment had not excited any fresh attack of inflammation. The specialist then told her to go home, but wrote to her several times afterward. The woman is well to-day, having had no further trouble.

Dr. Nunn said that last February a woman had come to him saying that she had been curetted, that she was suffering intensely from the pain in the right side, and that a gynæcologist had advised removal of the ovary on that side. Dr. Nunn's examination had failed to show anything but ovarian neuralgia, and he had accordingly treated her with the unidirectional interrupted

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galvanic current. She left the office without pain, and for two months she was under treatment. During this time there was no return of the pain, but his own illness had necessitated a discontinuance of the treatment, and he had accordingly lost sight of her.

DR. R. REYBURN said that he had treated about half a dozen cases of fibroid with electricity. In all there had been improvement, and three had been practically cured, the hæmorrhage having ceased and the tumors having been reduced to the size that gave rise to no further discomfort. Such a result should be a warning to some of our friends not to be too ready with the knife in this class of cases.

DR. FRANCIS B. BISHOP, of Washington, D. C., said that, apropos of mistakes in diagnosis by surgeons, he desired to report the following: A woman had been taken with abdominal pains, and subsequently with stercoraceous vomiting. Obstruction of the bowel was suspected, and a surgeon was called in. After a careful examination he had counseled delay. A gynæcologist had then been summoned, and had very carefully gone over the woman's history from childhood up, after which he had stated positively that nothing could save the woman's life but immediate operation. The patient demurred and asked the speaker to give every other measure a fair trial first. The treatment consisted in giving high enemas with the patient in the knee-chest position. This relieved the constipation, and after a short period of treatment she completely recovered.

DR. HALL-BROWN said she had had three cases of fibroid tumors where complete hysterectomy had been performed. One of these cases made a good recovery, and had remained well. Another case had apparently recovered, but had developed melancholia and had committed suicide three months after operation. The third had died three days after operation.

DR. WILLIS E. FORD was asked to make some remarks. He said: I am sorry that I was not here this morning when mention was made of Apostoli. Let me say that, while he was a good electrician, he was also able to make a correct diagnosis. At the time I was there, Dr. Cushing, of Boston, was also present. We dined with Apostoli and went to his clinic. One afternoon, on invitation, we examined his patients as they came. We examined some forty in all, and were very much impressed with the results and with the testimony of the women who came, and also with the elaborateness and accuracy of his notes. His work we found to be certainly what he claimed it to be. We found only one case in which we thought there had been a mistake in diagnosis, but, of course, it was quite possible that Apostoli was correct, and we were not. I saw his apparatus for the treatment of nervous disorders by the high-tension currrent, and was very much impressed with his work. His position in Paris among gynæcologists, with whom I was more familiar, was as "the fashionable man in Paris." They said that his work was skillfully and honestly done, but few of them believed that his reports on the treatment of fibroids were not strictly accurate. I am glad to take this opportunity to bear testimony to the honesty with which he reported his failures, and also to the painstaking way in which he did all the work at his clinic. Two years ago I had the pleasure of defending one side of the question of electricity in the American

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Gynæcological Society in Boston. My views regarding the use of electricity have not changed particularly, though my gynæcological work is at present largely operative. I have in no way lost faith in electricity, though I believe that much of the nonsense written about it by those knowing a good deal about electricity and too little about medicine and surgery does much harm to the cause of electro-therapeutics. Of course, electricity is not taught generally in our schools, although I give two short courses each year on this subject: one in New York and the other in Buffalo. I tell my students that the field of electro-therapeutics is small, but it is a very fertile one. If the ailments which can be easily and rationally reached by electricity are studied carefully and a proper knowledge of electricity is attained, the profession at large would do a great deal more with electricity. I am not, then, an enthusiast, but nevertheless a very strong believer in the value of electro-therapeutics.

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COMBINED ELECTRIZATION, OR GALVANO-FARADIZATION.

By A. D. Rockwell, M.D., New York.

By combined electrization is meant the simultaneous application, through the same electrodes, of the two forms of dynamic electricity: the galvanic and faradic currents.

Many years ago I wrote as follows about this method: "In order to secure the advantages of both currents and at the same time avoid the trouble and inconvenience of employing them in succession or alternately, as is sometimes desirable, we have devised a method of using them simultaneously. To this method we have given a name which sufficiently expresses its character, viz.: galvano-faradization. Whether any special therapeutic advantage arises from the simultaneous use of the two currents we are unable to say."

On account of the inefficiency of apparatus and the difficulty of utilizing the combined currents the method was long held in abeyance; but some three years ago I was again induced to experiment with it, because of a new and improved construction which was then brought to my attention. This apparatus, with some necessary modifications, was described by me in the *New York Medical Journal* of March 5, 1898, and has since constituted a valued part of my electrical outfit.

More recently, however, still further improvements in the methods of combining the two currents have been made, and in the apparatus here presented we have an almost-ideal arrangement for every possible utilization of the dynamic forms of electricity. To determine the differential indications for the use of these two forms of electricity is sometimes no easy matter. We know, indeed, that the faradic is a current of to-and-fro motion, of constant closing and breaking, and through its vibratory action gives passive exercise to both deep and superficial tissues. I believe that the contractile fibre-cells are influenced more powerfully by interrupted high-tension and high-frequency currents than by the chemical, or galvanic, current, and that there is greater stimulation of waste and repair. The galvanic current, on the other hand, with its far-greater ampèrage, affects the brain, spinal cord, and sympathetic more powerfully than currents of even the highest tension and frequency. This high ampèrage gives it also a far more potent electrolytic and ther-

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mic action and a greater influence over secretion. Although the differences between the two currents, and, indeed, between all forms of electricity, are mainly differences of degree rather than of kind, yet so widely do they differ in some of their physical and physiological manifestations and in their therapeutic effects, that it amounts practically to a difference in kind.

It has always seemed to me, therefore, that the combination of electric currents so called is quite as rational as are drug combinations. Practically I have found such to be the case, and have witnessed some very interesting effects, physical, physiological, and therapeutic.

Physical Effects. — The transference of substances from one pole to the other, the production of heat, and the regulation of endosmose and exosmose are the main physical effects of the passage of electricity through the body. The faradic current alone has very little effect on endosmotic phenomena, which evidently depend on the chemical rather than on the mechanical power of electricity; but the galvanic current stimulates ordinary endosmotic action in a marked degree. Add, however, to its chemical influence the mechanical influence of the faradic current, and we get even greater stimulation of the endosmotic phenomenon than when one current alone is used. Increased heat-production is also a noticeable effect of combined electrization.

Physiological Effects.—The physical as well as the chemical and mechanical effects of electricity are not, like physiological effects, peculiar to the living body. Inorganic as well as organic substances are influenced by the first three, while the latter takes place only by virtue of the vital properties of the body. Physiological effects cease when life ceases, and are therefore pre-eminently important in the study of electricity in its relation to the human body.

The physiological effects of electricity through its action on the nerve-supply are seen mainly in its influence over the circulation and on secretion, excretion, and absorption. Both currents and all forms of electricity influence the circulation and the secretory and excretory processes, and even the absorption of morbid products is, in all probability, accelerated by currents of low as well as high ampèrage.

The average ultimate effect of electrization is to increase the flow of blood, raise the temperature, and dilate the veins. This it does through its influence over the capillary circulation, which is

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regulated by the quantity and quality of the innervation that it receives.

The combined chemical and mechanical effects of electricity ought theoretically to heighten innervation more vigorously than these effects uncombined the one with the other, and my observation and experience has fully satisfied me that the method under consideration increases the effect of the usual methods of electrization not only on the circulation, but on those most important bodily processes: secretion and excretion. Whether combined electrization is equally efficient on the absorbents is less easy of demonstration.

Its influence over secretion becomes immediately evident, subjectively as well as objectively, while its effect on absorption is wholly objective, and becomes apparent only when applications are made to fluid or solid deposits. This point is to be determined, therefore, by the systematic study of pathological cases.

Therapeutic Effects.—If it is difficult to determine the differential indications for the use and the comparative value of the different forms of electricity in individual cases of disease, it is still more difficult to say just to what extent and in what cases combined electrization is superior to simple or single electrization. It certainly will not relieve pain from whatsoever cause as readily as simple electrization. All forms of electricity—galvanic, faradic, static, sinusoidal—will relieve certain conditions of pain, as is well known—one succeeding where the other fails, and *vice versâ*.

The pain that is not increased by pressure, and especially if pressure affords any manner of temporary relief, is far more likely to be benefited by the *faradic* or *sinusoidal*, or by any of the high-frequency or high-potential manifestations of electricity, while painful parts, sensitive to pressure, barring the hyperæsthesia of hysteria, are, as a rule, affected more favorably by the galvanic current. On the contrary, combined electrization seems to me not only to have failed in several cases representing the two conditions to which I have alluded, but to have increased rather than to have allayed pain. I can account for this only from the fact that in the impaired sensibility to pressure of the one condition mechanical effects alone are called for, while the increased sensibility of the other calls for the continuous and more sedative action of the current of chemical action uncombined with mechanical effects.

But, if combined electrization possesses no superiority over single electrization in the relief of pain, I am quite sure that it has

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a field of its own in the treatment of spasmodic conditions. Long ago a distinguished English physician in an article on chorea said that "electricity is another agent which requires a passing mention in this place, though all that can be said respecting it is that, as yet, there appears little or no reason for placing any confidence in it as a means of treatment. Whether this will always be the case, whether there are not modes of using electricity which will have the effect of quieting choreic and analogous movements, remains to be seen. I suspect that there are such modes, and that they will be beneficial, but I have not yet the facts to justify the expression of a belief on the subject."[1]

In the light of later experience this seems little less than prophecy. We now know that electricity does benefit chorea and other spasmodic conditions on the same principle that it benefits neurasthenia and other functional nervous diseases, by reason of that indirect improvement in nervous force which is a part and a result of the general improvement in nutrition.

Musculo-sedative effects are obtained in greater or less degree by nearly all the various methods of electrization and in a marked degree by combined electrization.

Its superiority in this respect over either current alone has been clearly indicated to me in several cases of local spasm.

In a case referred to me by Dr. L. Bolton Bangs, the result, though temporary rather than permanent, seemed to me to demonstrate this superiority very positively. The case was one of urethral spasm. On introducing the electrode, its progress was arrested by a vigorous muscular contraction, first in the middle of the urethra, and, when this was overcome, by a second spasm in the deep urethra.

Steady pressure alone would successively relax these spasms after awhile, but under the influence of combined electrization the spasm relaxed instantly, and the electrode entered the bladder without hindrance. Neither the galvanic nor the faradic current alone would act with anything like the celerity of the two combined. In another case of spasm of the pharynx in which neither current alone made any impression, the spasmodic action invariably yielded to combined electrization. In a case of facial spasm of long standing, referred to me by Dr. George H. Cocks, the relative superiority of

[1] C. B. Radcliff, M.D.: "On Chorea," "Reynolds's System of Medicine," 1868.

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combined electrization was very distinctly shown. For three weeks the faradic current had been repeatedly applied by Dr. Cocks. Subsequently I myself administered the galvanic current, but with no result. Combined electrization was then attempted, and resulted in a rapid amelioration of every spasmodic symptom. In a very interesting case of paralysis of the diaphragm I was able to satisfy myself that this combination of mechanical and chemical effects stimulated the phrenic nerve far more powerfully than either current alone, and greatly accelerated the recovery.

The symptoms of exophthalmic goitre are more readily ameliorated by combined than by single electrization. If this condition is due to disease of the sympathetic, it is evident that vasomotor phenomena can be more readily controlled by the former than by the latter method. If it is due to disease of the thyroid (hyperthyroidation) rather than of the nervous system, here, also, the combined method ought to be, and is, more efficacious than the currents uncombined in preventing toxic overproduction, or in eliminating such toxin from the system.

These reflections and brief clinical reports are presented as merely tentative and suggestive, with the hope that others may be induced to record and present their experience with this interesting form of electrization.

The most important point to be determined, however, it seems to me, is its relative influence over nutrition. Electricity, in passing through or acting on the body, modifies the nameless and numberless phenomena, every movement going on in the living tissues, and indisputably becomes an aid to nutrition, no matter what the special form employed. We get these results through the complex mechanical, physical, chemical, and physiological action of electricity, all of which are united in highest perfection in the combination of the currents.

DISCUSSION.

DR. MASSEY said that he had had the pleasure to-day of seeing the apparatus described by Dr. Rockwell in this paper, and it seemed to be an excellent one for the utilization of the Edison mains both for the galvanic and faradic currents. De Watteville, in his excellent work on electro-therapeutics, had done a good deal toward bringing combined electrization into prominence. There was a very convenient arrangement of switches, known as the de Watteville combiner, that permits of the easy use of the combined currents. Galvanic and faradic batteries can, however, be easily combined by connecting the nega-

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tive of the galvanic with the positive of the faradic battery, and setting both in action, the combined currents being preferably governed by the controller. In this simple arrangement the positive pole of the galvanic battery becomes the combined positive pole, while the negative pole of the faradic battery becomes the combined negative pole. The connections can be reversed, of course. In this way anyone with two batteries can easily have the combined currents. There was a distinct value in galvano-faradic electrization, which was explicable on consideration of the subject of electrotonus. It had been shown by Waller, and published in the "Transactions of the (English) Royal Society" a number of years ago, that in combining the two currents and placing the electrode over a nerve, for instance, that the passage of a small portion of the galvanic current through the circuit would increase or decrease the contractility of a given nerve to the faradic current: in other words, it was used by Waller, a physiologist of England, to demonstrate and measure the effect of electrotonus. At the negative pole the galvanic current would cause the faradic current to be more active, and at the positive pole less active. This seemed partly to indicate the value of the combined current. By taking the electrodes in the hand, after having set the faradic for a current which will just tingle the hands, and then turning on a galvanic current of 5 milliampères, it would be found that there would be a very distinct increase in the faradic contraction, due to a neural change.

MR. R. G. BROWN asked how an apparatus could be constructed so as to put the combined current through the patient, because, to his mind, one short-circuits through the other.

DR. W. H. WHITE said that in the de Watteville switch with the five-point contact the current would run around. On shutting out the galvanic current a different buzzing note would be heard.

DR. A. D. ROCKWELL said that the fact was perfectly demonstrable with his apparatus, although it might be difficult to demonstrate it mathematically or on the blackboard.

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THE MORTON WAVE-CURRENT: A VALUABLE ADDITION TO ELECTRO-THERAPEUTICS.

By William Benham Snow, M.D., New York.

One year has passed since we first called the attention of the association to the value of this current, with which, at that time, most of the fellows present were unfamiliar. Several who were there recognized in it a current which had not been called to their attention, though published in this country by Dr. W. J. Morton on March 4, 1898. Such took interest to familiarize themselves with the technique, and several have since reported satisfactory results from its application.

That the technique might be more generally understood by the profession, we published a short article on the subject in the *Medical Record* of March 3, 1900.

Familiarity with the current for six months before its publication, by Dr. Morton, and since in a large clinic and practice exclusively electro-therapeutic has afforded an opportunity for observation which justifies the making of positive statements of which there are now facts to confirm.

The wave-current is unique in many characteristics:—

1. It is the only published current administered from but one side of the generator.

2. It is the only current in which the alternations are of charge and discharge.

3. It is the only current administered to the patient while insulated.

4. It is the only current with an immense potential that can be passed to and fro through the body with so little danger and discomfort.

5. It is the only current in the passage of which the body receives general electrification, with the surgings of the current traversing the tissues of the body. Spark discharges from the surface, or so-called potential alternation, are not considered to be currents, but the rhythmically regulated passage of electricity not requiring constant manipulations of an operator, as the constant, induced, or static induced currents do.

The very nature of the wave-current makes it the choice of all currents if there is therapeutic virtue in electricity. For it repre-

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sents the greatest possible expenditure of electromotive force upon the patient. It is impossible to get something from nothing, but by the laws of the conservation of energy little is lost and the working force of the power becomes electrical energy to be expended upon the patient. The fact that it penetrates every remote part of the body, if for good, makes it superior to all currents passing directly between two electrodes. The current is so controllable that it may be applied to the eye or may stimulate powerful contractions of the muscles of the thigh. In its application it is a substitute for every other current, except the polar applications of the constant current, to purposes requiring quantity and low voltage. The constant current is a destructive current, a disarranging current, a slow team. Who can say that in passage between electrodes it does not, in the main, take the blood-channels? Once started, the coats of the blood-vessels would add resistance and insulate it. Perchance the muscles are the good conductors. One thing is certain—it takes the channel of least resistance and goes around and not across, which cannot be held as true to the same extent of displacement currents of great voltage.

The currents of great frequency and high potential of d'Arsonval, which have given so much satisfaction abroad, employ but 1500 volts with safety, while a wave-current of 1,000,000 volts may be administered without danger or discomfort to the average patient. The ampèrage, the mischief-making feature of the constant current, is not brought to the low ratio to the voltage in the machines of d'Arsonval as in the currents of the influence machine. The same is true of the currents of the sinusoidal machine. Consider the faradic battery on the basis of its first source of energy for work to be done (a few cells of battery) and we have in it, at best, little but a good source of reflex impressions, and the much-talked-about psychical, suggestive effects so disgusting to the faithful electro-therapeutist, when charged to his department as the only therapeutic virtue of his art. Much good might come from such effects, but is it surprising that our art has stood so low in favor with the profession when we consider the real worth of the "galvanic" and "faradic" currents of our college-days? It was food for the imaginative, but not satisfying to the sterner nature.

We have gradually merged from the dark period of our history, and now with the currents and other forms of administration of the modern influence machine, together with the machines of d'Arsonval, delegating the constant current to its own field, where

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noble work will be done, electro-therapeutics is winning friends and recognition daily.

Years of experience and careful observation justify these conclusions, and time will demonstrate and confirm their truth. Results that are being accomplished by new currents and scientific methods are so convincing that no prejudice can withstand the array of facts.

The physiological actions of the wave-current are the result, first, of the surgings to and fro from electrode to surface of patient, with influences peculiar to the passage of electricity of great electromotive force and infinitesimal quantity, and comprise the *constitutional effects*; and, second, the intense vibratory and peculiar electrical effects upon the tissues immediately beneath the electrodes—*the local effects.*

The constitutional effects are:—

1. Marked lowering of arterial tension.

2. Lessened frequency of heart's action with increased volume of pulse.

3. Increased oxidation and metabolic activity, marked by body-warmth, deepened inspiration, increased production of CO_2, increased elimination of solids, with marked functional activity of the organs of secretion and excretion.

4. Marked diminution of nervous irritability with sense of drowsiness.

5. Sense of fatigue if sitting is too prolonged. Administrations of powerful currents for one-half hour may be well borne and of advantage in well-developed patients, while a mild current (measured by 1-inch spark-gap) for fifteen minutes may be sufficient for others

6. It has been demonstrated that patients receiving local treatment for from forty-five minutes to two hours daily for periods of months gain body-weight, become less anæmic, and improve generally in health, in absence of any drug administration, and while taking no bodily exercise. We may add that the current is absolutely harmless and a powerful tonic.

The local effects are dependent upon several conditions:—

1. The size of the electrode.

2. The length of the spark-gap (the measure of electromotive force).

3. The nature of the ground connected to the grounded pole. (During application to sensitive areas, as the forehead, eye, ear, nose,

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and throat, it is best to operate without the pole being grounded at all; but in all other cases have best grounded connection obtainable.)

4. Upon the rapidity of alternation and voltage in relation to parts treated (large muscles require greater voltage and small ones less) will depend whether rhythmical contractions, physiological tetanus, or sedation is produced.

5. Polarity, so far as has been discovered, does not affect the result in the employment of the wave-current. This statement is based upon careful observation.

Observing the above rules of technique, the *local effects* are as follow:—

1. A sense of vibration marked over muscles when there is little underlying fat by rhythmical contractions.

2. Physiological tetanus is produced where voltage and alternations relative to muscle are applied.

3. Sedation of pain and nervous irritability is produced by prolonged and gradually increased dosage as toleration permits.

4. It is an antispasmodic, muscular spasm being often overcome by prolonged administration of sufficient voltage to fatigue the muscle.

5. Glands beneath the electrode are stimulated to active secretion.

6. Local congestion and hyperæmia, when not due to specific poison or necrosis, are relieved.

7. Metabolism is most active beneath the electrode.

The therapeutic range of application of the wave-current, suggested by its physiological action and demonstrated by experience, is very large. It is often used with advantage in connection with some of the other forms of static administration, which it is impossible to consider except in a treatise on static electricity. As a general rule, it gives better results than sparks, except where deep structures require an intense local effect, or where small muscles contract too painfully to allow the use of an electromotive force sufficient to affect the condition, as occurs in the treatment of brachial neuritis, or the hands in rheumatoid arthritis, or in cases requiring positive reflex stimulation, as locomotor ataxia, or paralysis of long muscles. The constitutional effects are such that it materially benefits all forms of functional derangement, the active oscillations of the current inciting general functional activity of each organ traversed. It thus becomes a most powerful tonic to all inactive or sluggish conditions. A person unable to take exercise on

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account of lost power of locomotion preserves a good appetite, clean tongue, good digestion, daily evacuation, and muscles in a tonic condition; gains body-weight; and recovers from anæmia during several months of treatment.

Chlorosis, anæmia, constipation, all atonic conditions, neurasthenia, insomnia, melancholia (due to functional derangement), functional menstrual disorders, rheumatic diathesis, and allied affections are relieved, due, probably, to increased metabolic activity and oxidation evidenced by increased secretion and excretion.

As functional disorders are relieved, so also it becomes an agency valuable in the treatment of organic disease. Tuberculosis, Bright's, asthma, etc.; especially valuable is it in the early stages of phthisis. To obtain the best tonic effects of the *wave-current*, a long vertically-placed metal electrode of lead or block tin (used because soft and pliable) one inch in width and the length of the trunk of the body, should be placed beneath the clothing, and a current, measured by a spark-gap of 1 to 4 inches, administered for from fifteen to thirty minutes daily for the first two or three weeks and later at increasing intervals. The length of sitting and voltage employed will depend upon the idiosyncrasy and physical condition of the patient. Fat persons require strong currents to overcome resistance of fat, whereas weak and emaciated persons are often fatigued by strong currents and long sittings. From the long electrode, easily placed beneath the loosened clothing over the vertebral column, the rapid surgings to and fro from the surface of the body to the electrode naturally include each viscus in the passage; hence the quickening of all vital functions.

The local therapeutic actions of this current place it at the head of the list of electro-therapeutic agents.

The vibratory sensation of varying intensity is the subjective tremor of which *tetanus*, *sedation*, and *fatigue* mark higher degrees of frequency and voltage.

In the treatment of paralyzed or atrophied muscles, if for any reason the *wave-current* is to be used instead of sparks,—as in Bell's palsy or anterior poliomyelitis, or other forms of paralysis, or atrophies in young children,—excellent results are obtained from the use of the current with infrequent alternations and voltage relative to the demands of the case.

Physiological tetanus is indicated only when a prolonged effect to produce fatigue in a muscle in a state of contraction may be desired,

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as in some cases of torticollis or of other muscular spasm. Cases not of long standing do not, as a rule, require such severe measures.

The sedative effects are remarkable, indeed, and of inestimable value for relief of pain and nervous irritability.

Most cases of neuralgia not due to local pressure, necrosis, or a specific poison yield promptly to applications of from ten to fifteen minutes, followed by relief, permanent or for many hours. Gastralgia is promptly relieved by applying a large electrode over the epigastrium. Pleurodynia, intercostal neuralgia, and ovarian neuralgia yield to local application.

Four cases—all that were treated—of coccygodynia were cured. The relief in this painful affection is so marked that for several days after but one treatment pain may not recur. Cardialgia of true or pseudo- angina is promptly relieved by the two effects, relieving pain and lowering arterial tension. Apply an electrode about four inches square over the precordial region and continue the administration until pain ceases. In neuralgia of the rectum place a rectal electrode well up in the rectum and employ a strong current. In the treatment of neuritis the wave-current is undoubtedly the best means discovered, especially in the first weeks, when it can be promptly cured without recourse to its sterner ally, sparks; the local congestion and consequent pain disappear. This fact was first discovered by the writer in January, 1898, in an effort to relieve a patient suffering from a severe tic douloureux; the relief was complete and continued for fifteen hours from the first administration, and was cured within a week. It was in this case that the plan of *bridging* was adopted, which is the key to success, to wit: having prolonged the treatment at a sitting sufficiently to produce a profound impression, take care that the next treatment follows before there is but slight return of the pain, lessening the frequency as the inflammatory symptoms abate, and longer periods will *bridge* the return. For success in electrostatic administrations there is no principle the adherence to which contributes more than this principle which we have chosen to term *bridging*. It is rarely necessary to make applications oftener than at intervals of twelve hours. Most cases of sciatica can be managed successfully by the application of one treatment daily. We have now the record of ten cases of acute sciatica in which the wave-current was employed within the first two weeks of the attack, all of which were cured within a week without other means, and in no case have the results been different. This result is

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obtained by placing an electrode, not too large, over the site of the lesion, and gradually increasing the length of the spark-gap and the speed of the machine, as it may be tolerated by the patient, making the length of the sitting for from fifteen to twenty minutes, as seems best.

The lightning pains of tabes are, as a rule, relieved by more or less prolonged application of the current. The effects are as of a specific when applied to irritable or spasmodic conditions of not too long standing, and long-standing conditions may often be relieved or cured by a prolonged course of treatment. This is accomplished through a restoration of normal tone to the parts, as well as to the system as a whole, due both to the constitutional and local effects. Under this heading we include vaginismus, spasmodic dysmenorrhœa, vesical spasm, spasmodic stricture of the urethra, convulsive tic, etc. Any improvised metal electrode will serve in absence of special ones as a sound, speculum, or catheter.

The twofold effect, local and constitutional, increases secretion and excretion of the whole glandular system. The indications for administration are therefore apparent.

The fact that this current relieves local congestion, or hyperæmia, which is demonstrated daily, opens a wide field for application, excepting only those conditions occasioned by a specific poison (we believe that germ-life is not affected by the current), necrosis, or solutions of continuity, as broken bones and ruptured ligaments. Enlarged glands due to congestions, which may lead to suppuration,—as of tonsil, prostate, or testicle,—treated early may save much suffering.

When hyperplasia or infiltration are present, with enlargement of a gland, as of the thyroid or prostate, much will be accomplished with the current. This has already been demonstrated with satisfaction in goitre, both simple and exophthalmic. The former have repeatedly disappeared and the latter were diminished in size, with marked lessening of tachycardia. For treatment of acute prostatitis, a rectal electrode having a concave surface for contact with the gland is used, or a male sound that will pass the gland in the urethra, or both.

Applied to sprains and bruises it surpasses all other methods of treatment. Cases, which under rest, massage, and cautery require months to effect a cure, are relieved and cured in a few days or weeks, unless a ligament has been torn off or ruptured. Cases which have

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become a chronic source of disability under other treatment yield and recover after patient treatment. Successful treatment of many cases of this most common of accidents demonstrates the truth of these statements.

Rheumatoid arthritis is generally assisted in its relief and cure in favorable cases by employing this current in combination with sparks. Numerous cases of rheumatism have been relieved and cured (at least temporarily) by the same agency. In the treatment of myalgias it is most agreeable and effective.

A great field is open for the wave-current in the work of the gynæcologist, excelling, as it does, the interrupted current as an antispasmodic, anodyne, or in the relief of passive congestion and cellulitis. No bipolar electrodes are required, and the results are, in every way, most gratifying and encouraging.

Without entering more into detail, the preceding outline will constitute a basis for the future study and constantly increasing scope of application of this most valuable electro-therapeutic current.

The statements made here are all based on actual results, many times repeated, and demonstrations that will be often met in the future to the satisfaction of the electro-therapeutist, the medical profession, and suffering humanity.

Results must depend upon the use of modern influence machines of high grade and capacity, and time, patience, and devotion to technique on the part of the physician.

154 West Thirty-fourth Street, New York City.

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SPARK-GAP CURRENTS; NAMELY, OSCILLATORY CURRENTS DUE TO A SERIES OF SPARKS PASSING AT A SPARK-GAP.

By William James Morton, M.D.,
Professor of Diseases of the Mind and Nervous System and of Electro-therapeutics at the New York Post-graduate Medical School and Hospital.

The increased attention which is given each year to therapeutic administrations, some of them novel, by aid of electrostatic machines, justifies, I trust, this passing attempt to classify these administrations, developed as they have been at irregular intervals of time during the last one hundred and sixty-six years. What is lacking is a proper nomenclature to express results obtained during the last twenty years, and this we still lack.

Our first step in classification is a simple one, for the general practice of electrical treatment from electrostatic machines divides itself into two epochs, namely:—

1. The epoch of the administration of sparks, breeze, and of the electric bath on the insulated platform (1734 to 1881) (direct).

2. The epoch of the administration, in addition to the above, of currents whose determining characteristic of production is a spark-gap and a series of sparks passing at the spark-gap, the resulting current being utilized at some other part of the circuit (1881 to the present time) (indirect).

These two epochs may be otherwise concisely stated as (1) the epoch of the single spark, which produces the instantaneous, transient, single current, or electrical impulse; and (2) the epoch of the series of sparks passing continuously at a spark-gap, producing a continuous effect and constituting sustained oscillatory currents. In brief: (1) the transient-current epoch (single spark, direct) and (2) the oscillatory-current epoch (series of sparks, indirect). The first epoch began in 1734, when the Abbé Nollét administered the first spark for a therapeutic purpose; the second began in 1881, when the writer read his first[1] paper before the New York Academy of Medicine, describing "A New Induction Current in Statical Electricity," namely:

[1] Read before the New York Academy of Medicine, March 3, 1881. See New York *Medical Record* of April 2, 1881.

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the static induced current, supplemented, in 1891,[1] by a much more extended statement of the same subject. Guided by these considerations, I suggest that we may, with advantage, divide the art of franklinization, a generic term now familiar, into:—

1. Single spark and convective discharge, direct franklinization (disruptive and convective discharges, direct).

2. Series spark, indirect franklinization (sustained oscillatory currents, indirect).

It is to the second epoch—namely: that of series spark, indirect franklinization—that I will especially ask your attention.

Series Spark, Indirect Franklinization, or Sustained Oscillatory Currents.

My attention was first drawn to producing currents, in 1879, on my return from Paris from a course of study at Professor Charcot's clinic, when I brought home with me two large influence machines and appurtenances and what books, old and new, on the subject I could find. I entered enthusiastically into a study—physical, physiological, and medical—of static electricity, and in 1881 published my first paper, already referred to. I soon observed that a series of sparks passing at any remote part of a circuit in which the patient was placed produced a continuous muscular contraction, namely: physiological tetanus in the patient. The observation surprised me very much. I turned to my copies of Mauduyt, Cavallo, Wilkenson, Adams, Abbé Nollét, Abbé Bértholot and others, as well as to more modern books, but could find no allusion to such an effect. Nowhere was a continuous muscular contraction alluded to, but reference was made only to the transient, instantaneous, and single contraction due to the administration of the single spark; and nowhere was a series of sparks passing at a spark-gap alluded to, but only a single spark, regulated as to force and length and producing a shock, "or single contraction," was described. My observation was a simple one, but it was novel, and its practice produced an important and new effect.

Immediately I had constructed for me, by Messrs. Berge & Co., of New York, various electrodes, which were simply two adjustable brass balls arranged on a handle conveniently for the passage of a

[1] Read before the New York Neurological Society, December 2, 1890. See New York *Medical Record* of January 24, 1891.

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series of sparks and for administration. These electrodes are illustrated in Messrs. Berge & Co.'s catalogues[1] of that date, and afterward were called pistol electrodes, owing to the shape of the handle, and the current was called the franklinic interrupted current. It was but a short step to the static induced current, where condensers were employed and the spark-gap established between the discharging rods. After publishing these facts in 1881, my attention was called to the Boudét electrode, which somewhat resembled my pistol electrode, for producing the simple interruptions (without condensers) in the franklinic current.

But, upon referring to Dr. Boudét's most admirable treatise upon electro-therapeutics,[2] I found that he made no claim of producing a continuing current, but that his electrode was simply for the purpose of regulating the length and strength of single sparks; and he nowhere speaks of a series of sparks across his spark-gap, which must necessarily exist to produce a current. Soon also my attention was called, in connection with possible currents, to the Lane electrometer. But here again, as in the case of the Boudét electrode, I found, upon reference to the copious literature in old books referring to the Lane electrometer and similar electrostatic pieces of apparatus, not the slightest reference to a series of sparks continuously passing at the spark-gap and setting up a current of any sort at some other point in the circuit; on the contrary, I found a most explicit statement of the purpose of the Lane electrometer, and this to the effect that it was employed, to quote from Mauduyt and others, "to furnish a sure and fixed measure of the force of the shocks."

If we examine the various illustrations of the manner of administering the regulated shocks by means of the Lane electrometer, we find that in all cases the terminal electrodes are metallic balls whose sole purpose must have been to deliver sparks, and one finds further that in the greatest number of these illustrations the administering brass balls are applied to the patient outside of and on the clothing. This fact alone proves that not current, but sparks, were administered, and agrees with the universal statement as to what purpose

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[1] "Franklinism, or the Treatment of Disease by Statical Electricity," etc. Published by J. & H. Berge, 191 Greenwich Street, New York City. Third edition; June, 1883.

[2] "Electricité Médicale," etc. Par le Dr. M. Boudét, de Paris. P. 125.

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the Lane electrometer was put. Also in the case of the ear and mouth electrodes figured by Mauduyt and others and reproduced by a friendly critic, its purpose is described to be an indirect spark administered, precisely of the type of the Boudét electrode, and no mention or description is given of a passing series of sparks which would establish a current. Indeed, no mention is made by the electricians of the last century of a current, or of the physiological tetanus which must have resulted from such a current, nor are any descriptions or illustrations given as to how to administer such currents. Their administrations were solely direct disruptive and convective discharges and the muscular response, transient and impulsive, but not sustained.

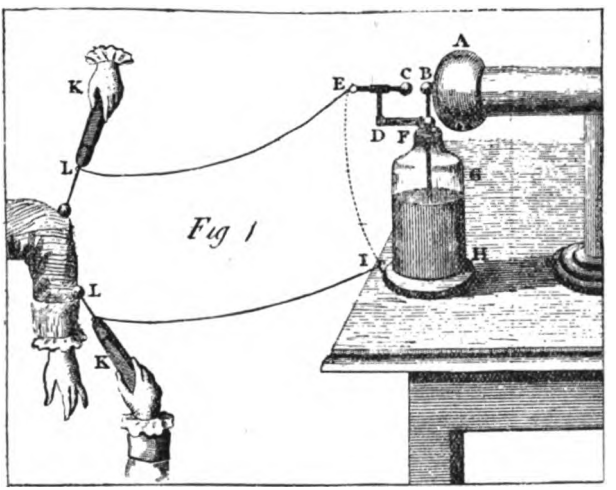

Fig. 1.—Lane Electrometer. (Cavallo.)

To demonstrate the method of using the Lane electrometer known to the ancients, it is only necessary to glance at an illustration which I reproduce from Cavallo (volume ii, Plate 5, Fig. 1),[1] and to quote briefly from the very brief description of the uses of the instrument (page 119, same volume): "Fig. 1 represents the electric jar with Mr. Lane's electrometer, and the manner in which the shocks are sent through any part of the body. The surface of

[1] "A Complete Treatise on Electricity, in Theory and Practice, with Original Experiments." By Tiberius Cavallo, F.R.S. Third edition, London, 1786.

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the jar, which is coated with tin-foil, should be about four inches in diameter and six inches high, which is equal to about seventy-three square inches." Then follows minute description of the lettered parts of the illustration: "When the shocks are to be given with this apparatus to any particular part of the body,—for instance, to the arm,—then, instead of the dotted line representing a wire, which must now be supposed as not existing in the figure, two slender and pliable wires (*EL, IL*) are to be fastened, one to the open ring (*E*) of the electrometer, and the other to the brass hook (*I*) of the stand (*III*), which communicates with the outside coating of the jar. The other extremities of the said wires are fastened each to the brass wire (*L* and *L*) of the directors (*KL, KL*). Each of those instruments, justly called directors, consists of a knobbed brass wire (*L*), which, by means of a brass cap, is cemented to the glass handle (*K*).

"The operator, holding them by the extremity of the glass handle, brings their balls into contact with the extremities of that part of the body of the patient through which he desires to send *the shock* (italics mine). The management and convenience of this apparatus are easily comprehended by inspecting the figure, for when the machine is in motion, and the apparatus, etc., is situate as in the figure, the discharge of the jar must be evidently made through that part of the patient's arm which lies between the knobs of the directors; and the operator, while an assistant keeps the machine in motion, has nothing more to do than to hold the knobs of the directors to the extremities of the arm, or to any other part of the body that is required to be thus electrified, always taking care that the two wires (*EL, IL*) do not touch each other, because in that case the shock will not pass through that part of the body which is required to be electrified. Thus, any number of shocks, precisely of the same strength, may be given, without altering any part of the apparatus or having any further trouble; and, when the strength of the shocks is required to be diminished or increased, it is only necessary to diminish or augment the distance between the balls (*BC*), which is done by slipping the wire (*CE*) forward or backward through the spring-socket that holds it. It is almost superfluous to mention that when shocks are administered it is immaterial whether the patient stands upon the ground, upon the insulating stool, or in any other situation whatever. It is neither always necessary to remove the cloaths from the part that must be electrified, in order to let the knobs of the directors touch the skin, for, except the coverings be

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too many and too thick, in which case part of them at least should be removed, the shocks will go through them very easily, especially if the knobs of the directors be pressed a little upon the part."

Mauduyt and all the other older writers of prominence describe in the same manner, though often more explicitly, the use of the Lane electrometer, and in all instances confine their description of its use to the measurement of the length and the strength of a single spark or shock. It must be recollected that with the large Leyden jars described—namely: having tin-foil coatings of about "73 square inches" and with what we should consider to-day almost toy electrical machines, having a single plate about one foot in diameter—it would be impossible to fill the large Leyden jars described with sufficient rapidity to secure the passage of a rapid series of sparks, even had it occurred to the operators and writers of those times to do so.

In December, 1890, being still interested in the subject of these currents, and having experimented with them further, I read a long paper before the New York Neurological Society, published in the *Medical Record* of January 4, 1891. This paper, illustrated by numerous diagrams and illustrations, explicitly described the various electrical arrangements and principles involved, and referred to the peculiar physiological action of such currents.

At this point I may remark that it is obvious that new facts had been brought to light: The first fact was that, if a spark-gap over which a series of sparks is continuously passing be introduced into the circuit of an influence machine or other high potential machine, then the current, which otherwise would be physiologically inert and inoperative, would become capable of doing work in some other part of the circuit, such as to set up physiological tetanus. (This was the franklinic interrupted current.)

The second fact was that, if the spark-gap and series of passing sparks be utilized in such a manner as to charge and discharge condensers, a current could be derived from the condensers which was also capable of producing physiological tetanus, and, as afterward proved to be the case, illuminate vacuum-tubes and bulbs and do other kinds of work. This was the static induced current. Both mechanisms represent equally condenser action and both produce oscillatory currents. Now, novelty depends, in a perfectly clear and simple manner, upon the spark-gap and series of passing sparks *combined* and so used as to produce current. If the ancients did this and published it, or if others in more modern times had done it and

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published it, no claim to novelty on my part could have a passing weight.

The ancients utilized the oscillatory discharge of a single spark; I sustain the oscillations in a continuous manner by continuously setting up the initial impulse by aid of a series of sparks. In the first case we have the ancient and well-known spark-effect; in the second the now equally well-known current-effect.

Recently a strenuous effort has been made by one of our members to prove that the facts announced by me in 1881 and in 1891 were not new, basing the contention upon the quotations I have just given from Cavallo. I can only say that I welcome and court honest investigation and criticism. To that end, and since the question has been raised by one of our own number, I would here ask the president to appoint a committee to investigate the facts and formally report at our next meeting. This should insure a fair hearing before a just tribunal to all concerned.

Prior to my publications of 1881 and January, 1891, nothing had yet been published about Tesla currents and Tesla effects, d'Arsonval currents and d'Arsonval effects, or of the similar work of Professor Thomson. My own paper was the pioneer in this direction of high-potential high-frequency currents. I had no help from their publications.

Strangely, observations about new things seem to be in the air at about the same time. Mr. Tesla's first publication in this respect was in the *Electrical World* of February 21, 1891, and entitled: "Phenomena of Alternating Currents of High Frequency."

Thus, also, Professor d'Arsonval communicated to the Biological Society, February 24 and April, 1891, the fact that, when the number of oscillations is very high, there is no excitation of the nerves and muscles, while his various forms of high-potential, high-frequency apparatus were published considerably later on.

Professor Thomson had placed his machine producing a high rate of alternations at the disposal of Dr. Edw. Tatum, of Yonkers, N. Y., and Dr. Tatum reported his results in a letter to Professor Thomson, December 29, 1890, and published in May, 1891.

Referring, now, to the electrical arrangements of parts and to the nature of the current produced, we can arrange them in the following diagrams (Figs. 2, 3, 4, 5, and 6) for purposes of comparison.

Upon examination of these diagrams one sees that the controlling fact is the combination of the spark-gap and series of pass-

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ing sparks with condensers. This is the case in Figs. 2, 3, and 4. It is thus obvious that Fig. 3, the Tesla current, is the static induced current of Fig. 2 fitted with a secondary wire to transform it upward,

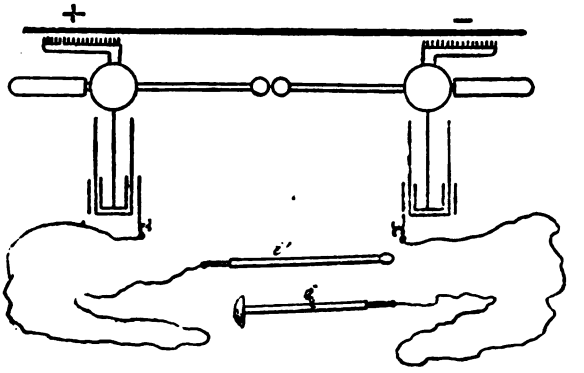

Fig. 2.—The Writer, March, 1881, and January, 1891: The Static Induced Current.

and that Fig. 4, a d'Arsonval current, is likewise the static induced current of Fig. 2, tapped at both ends of a solenoid to secure its self-induction. These dates and facts I mention, since, in my memoir

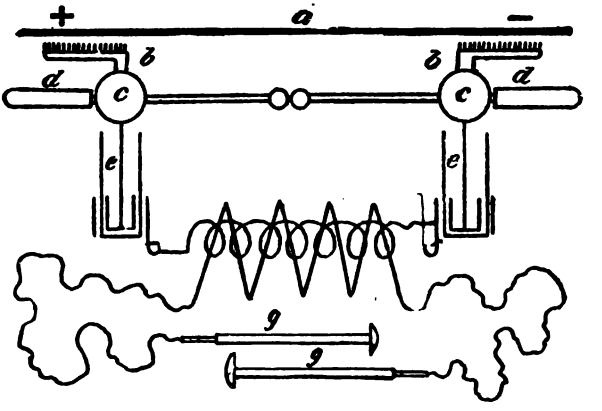

Fig. 3.—Tesla, February, 1891: Tesla Currents.

of 1891, I dwelt at length upon the high potential and high number of oscillations to be derived from condensers, namely, high-potential, high-frequency currents, and since it has often been said that the

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conclusions arrived at in this memoir had been derived from Mr. Tesla's writing and experiments. As a matter of fact, my mainstay and guide in my investigations and experiments was a work always inspiring to me in electrical thought, and that was and is Dr. Oliver J. Lodge's "Modern Views of Electricity" and his various other writings.

The combinations of spark-gap and series of passing sparks in an electrostatic machine may also be utilized to produce the "electric wave-current." A description of this method has appeared in the *Bulletin Official de la Société Française d'Electro-Thérapie,* Janvier et Fevrier, 1899, and in the New York *Electrical Engineer* of March 2, 1899, and also later on, a year ago, at the Washington meeting of

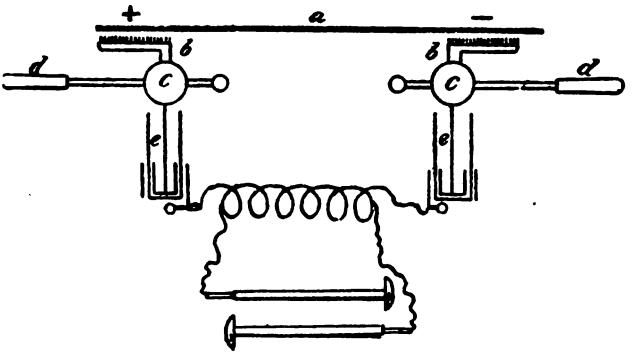

Fig. 4.—D'Arsonval: D'Arsonval Currents (One Variety).

our association, in a paper on this subject by Dr. W. B. Snow. It was at first termed wave-current because its circuit produced Hertzian waves. The current is obviously oscillatory.

The connections to produce the wave-current are given in Fig. 5.

A modification of this method is shown in the next illustration (Fig. 6). A metallic foot-plate, upon which the patient's bare feet rest, is connected by a rheophore to an extraneous and independent insulated capacity. I generally employ for this attachment a zinc sheet of metal two feet by five feet in size, supported upon insulated tripod legs. Any other metallic electrode in any other situation upon the patient's person may be substituted for the metallic foot-plate.

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To summarize, in conclusion, we have two forms of franklinization:—

1. Single spark and convective discharge, direct franklinization.

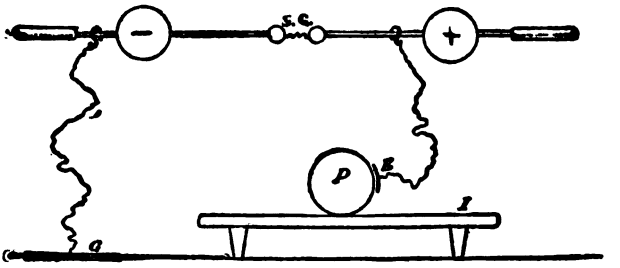

Fig. 5.—Insulated Platform; *P.*, patient; *E.*, electrode; *G.*, ground connection; *S. G.*, spark-gap.

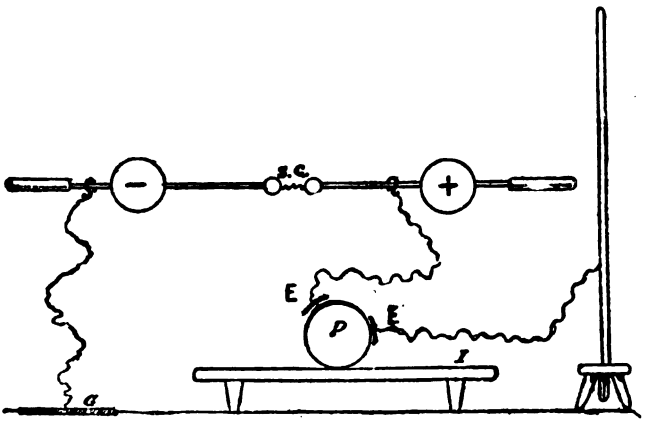

Fig. 6.—*I.*, insulated platform; *P.*, patient; *E.*, electrode; *E'.*, second electrode; *S. G.*, spark-gap; *I.*, insulated capacity.

2. Series sparks, indirect franklinization, namely: sustained oscillatory currents due to a spark-gap and a passing series of sparks in a part of the circuit remote from the patient.

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Of the methods of application in therapeutics I prefer the electric wave-current. It embodies, from every point of view, both the practical and the theoretical advantages of oscillatory currents.

DISCUSSION.

DR. MORTON said, in answer to a question from Dr. Herdman regarding the therapeutic action: I feel that this wave-current embodies all that can be obtained from an electrostatic machine in the current form. What does it do? In the first place, it produces muscular contraction of a painless type; so that it may be used in all cases where you desire to produce muscular contraction. An equal effect is produced on the sensory nerves. This effect may be compared to that of the very high potential current of any kind. In the next place, if you use the current vigorously, as with any high-tension current, you produce a fatigue effect. One gentleman has argued, in using this current, that it is better to produce the fatigue effect for the sake of the benefit experienced in the succeeding twenty-four hours. My own practice has been to give this current much as I would prescribe horseback-riding. One patient can ride only a few miles and feel well thereafter, while another can derive benefit from a very long ride. I have not gone further into the physiological effects. I presume that effects are produced on the general nutrition and on assimilation, and that, in short, the d'Arsonval physiological effects are produced. I use it in cases of neurasthenia, and in all cases where I wish to produce an improvement of the general nutrition. I also apply it locally as I would the faradic or galvanic current and for the relief of pain. Perhaps one of its most marked effects is this analgesic and anæsthetic action. I find the wave-current pleasanter to take and more diffusive than the static induced. It is quite as easily localized; hence I prefer it to the static induced current.

DR. W. J. HERDMAN, of Ann Arbor, Michigan, asked Dr. Morton if he did not consider that the chief difference is in a larger range of muscular wave.

DR. MORTON replied that more of the entire body is in the condition of charge and discharge, and therein lies the chief advantage. There is no special advantage in the intensification by means of the insulated metal plate, as described in connection with the demonstration just given. The spark could be made as fine as desired, even so fine that the current could be readily applied to the eye. There were various ways in which the spark-gap could be used. The spark-gap is placed between the discharging rods to secure this current.

DR. MASSEY suggested a different name for the last current alluded to. It appeared to him that the current-quality—the transmission of the complete current through the body—was less prominent than merely the transference of the potential to that portion of the body; hence, he would suggest, as a better name: "the potential wave." It was not, as stated previously, the highest expression of the chemical power of static electricity; it was a mere shunt. The resistance in that shunt is the air in the room; hence the air between the poles of the primary conductors is less of an insulator than the air of the room. He did not wish to oppose the appointment of a committee to investigate this

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question of priority, but if such a committee were appointed he desired to testify to the originality of Dr. Morton's views.

DR. A. D. ROCKWELL said that he was very glad that Dr. Morton had at last condescended to take the profession into his confidence as to the source of his inspiration, but there seemed still to be many important omissions. Some of those present were aware that there had been a controversy between Dr. Morton and himself regarding the originality of the discovery of the static induced current. Personally, he could not comprehend how Dr. Morton could make such a claim. If those who read his article of March 3, 1899, in the *Medical Record* think that Dr. Morton is worthy of complete originality, they are entitled to their opinion. He had never denied originality to Dr. Morton, but that his ideas had been evolved from certain sources which he had never publicly recognized before. He was willing to admit that this wave-current had considerable value, yet it had really been used for many years. The term "vibratory potential" seemed to him a better one. He had used static electricity with the greatest satisfaction for many years, but he did not think we should be misled by putting it on too high a pinnacle. It would be unfortunate if static electricity were really superior to the other forms, because comparatively few could possess the necessary apparatus. He thought every therapeutist and physicist would admit that there are many effects to be obtained from the dynamic form of electricity which are obtainable from the static machine.

DR. FRANCIS B. BISHOP said that at one time he had had a patient with severe neuritis, and to this person the wave-current, obtained with even the smallest spark-gap, had been irritating.

DR. HALL-BROWN said that she had been asked to speak on the practical use of this current. One obstacle to its use was the very loud noise made by the machine. To obviate this she had first inclosed the spark-gap in a large cylinder of glass. In order to secure good contact between the electrode and the patient she made use of block-tin, and carried it down along the spinal column most easily by means of a flexible rubber ruler or director. She had found that, unless the skin was moist, the patient would complain of pain. The strips of block-tin can be easily kept smooth by the use of a squeegee roller obtainable in photographic supply-shops. By the use of an old-fashioned chair with a high back and the application of a roller cushion to the back of the neck the requisite pressure is assured to secure good contact. She made use of this current for neurasthenia and neuralgia. One case was cited of a woman who had been troubled by scanty urine of low specific gravity (1010) and urea —5 by the Doremus test. No medicines were prescribed, and after four electrical treatments the urine had risen from 28 to 58 ounces in the twenty-four hours, the specific gravity was 1015, and the urea by the same test was + 5. With this change in the urine the patient's subjective symptoms were controlled.

For gynæcological work she had devised an arrangement for giving this current in the recumbent posture in a room adjoining the one containing the machine. A common table is insulated by having the legs terminate in glass telegraph insulators. The current is brought into the room by a wire insulated with rubber and inclosed in a glass tube. She had treated a large number of cases of coccygodynia, neurasthenia, and chronic or subacute appendicitis in

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addition to the usual gynæcological cases. It was very common for an enlarged and tender ovary to be associated with a displaced kidney and a mild appendicitis. In some cases she had placed the electrode in the vagina, and again over the appendix, and again over the kidney. All such cases had been relieved, and in some a cure had been effected. She had not yet treated any cases of fibroid tumors by this method.

DR. C. R. DICKSON said that it was well known that an investigator often makes an important discovery, but gets no further, and the discovery lies buried for a long time. When another person takes up this discovery, makes it known, and shows many of its practical applications he deserves as much, if not more, credit than the original discoverer. He had been greatly interested in the demonstration given. Recently he had made some experiments on the treatment of fibroids, of goitre, of neuralgia, and of peripheral neuritis. In the last-mentioned class of cases the results had been satisfactory, and had been more quickly obtained than by other methods. The method proved to be of great value in sciatica and peripheral neuritis. He was unable, as yet, to speak with positiveness concerning the effect of this current upon goitres and fibroids.

DR. M. A. CLEAVES, of New York City, thought there was little doubt that the current described this afternoon had greater therapeutic value than other methods of administering the franklinic current. Static electricity was capable of being used conductively, inductively, or disruptively. If used conductively, it might be used with the Leyden jars in circuit, or it might be used with the patient insulated, as illustrated this afternoon. In both instances there was the same application. With the conductive method, with the Leyden jars, these jars are discharged, and so it is with the method just demonstrated. By the disruptive method the grounded area corresponds with the other coating of the Leyden jar. The reason the wave-current is so much more valuable is that one is capable of expending a greater amount of energy within the tissues of the body without causing discomfort. The disruptive charge is extremely painful, and many patients would not tolerate it. By the conductive method described this afternoon it was possible to expend energy for long periods of time without causing pain, and at the same time to set up profound changes in the general nutrition. It had seemed to her that the method was indicated more in pathological processes of longer standing than in the more recent conditions. After the first applications the patients complain much of fatigue. She had used it in neuritis, rheumatoid arthritis, neurasthenia, and in gynæcological work, especially in prolapse, and had found it an agent of exceedingly great value.

DR. W. H. WHITE, of Boston, said that he had been using this current for a year in neurotic conditions, and with good success. The pain experienced by Dr. Bishop's patient might be because he used a sponge, and did not effect a direct contact with the skin. The tinsel cloth seemed to him an old idea, for he had made use of it in what he called frictional electricity. The patient is fixed as for the static bath. Some patients are extremely sensitive, and cannot bear a metal electrode. He had, therefore, had a very large mitten of this material made to conform nicely to any part of the body. The manipulations are carried out very quickly, and the skin is reddened.

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DR. F. B. BISHOP said that the case he had referred to was one in which a tumor had been removed from the arm over the course of the radial nerve. This operation had resulted in a very severe neuritis of the radial side of the hand. He found on using the wave-current that it was necessary to make the current so extremely fine that in damp weather the machine would discharge itself very soon. He had therefore taken off the grounding circuit, and had thus obtained a very fine vibration, which the patient could readily bear.

DR. W. J. MORTON, in closing the discussion, said that by not grounding one of the poles the current was made very much milder and pleasanter. As to the stinging sensation upon the skin, he had always found that it was necessary to bring the metallic electrode into very close contact with the skin. If a wet sponge were used, another spark-gap was thereby introduced. He had been deeply interested in the ingenious devices introduced by Dr. Hall-Brown. Dr. Cleaves's comparison with the coatings of the Leyden jar, even though the condensers are not used, was certainly a true one. He made use of the metallic cloth a great deal.

Regarding Dr. Rockwell's remarks and criticisms, he would say that Dr. Rockwell claimed to find an account of the static induced current in these very old books which he, Dr. Morton, had himself presented that afternoon. But he had endeavored to show this afternoon how the ancients had obtained their current. They placed their metallic electrode upon the clothing of the patient. In order to produce these currents the electrode must be brought in contact with the skin, and a rapid series of sparks must pass at the spark-gap. So far, not the slightest evidence had been brought forward to show that the ancients ever produced physiological tetanus or continuous muscular contraction, or anything of the sort. When the faradic induction currents came into vogue in 1834 or 1836 this was the first time that physiological tetanus was a prominent feature of current-effects. It was more than probable that, if physiological tetanus had been produced before this from electrostatic apparatus, the ancients would have been so astonished that they would have said something about it in some of their books. The spark-gap is as old as the static machine. He wished to ask Dr. Rockwell if he were an ancient and were treating a patient just as had been copied from the old books on the blackboard, the sparks passing through the clothing as pictured, how long the patient would have stood it? Such an application would be very painful, and if continued for any length of time would cause a slough. The fact that the administrations were made through the clothing shows that they gave nothing but an individual and single shock. Dr. Morton said that he had produced a rapid series of shocks, and hence had produced a new effect.

DR. ROCKWELL replied that the diagram certainly did not indicate the proper method of giving the current in question. He would refer Dr. Morton to Tibbitt's book, where the electrode is applied directly to the skin. These old writers did not use the word physiological tetanus, but they described accurately physiological tetanus. Dr. Rockwell went on to say that he had known these facts for so many years that he thought Dr. Morton should acknowledge the sources of his original information. Dr. Morton had not done this, and it was on this account that he had criticised him. Dr. Morton had

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obtained his information directly and almost entirely from the source which he, Dr. Rockwell, had pointed out.

DR. MORTON said he would again press his request for the appointment of a committee from this association to investigate this matter. He would deny that he had concealed anything. He had never attributed any importance to these ancient pictures and writings as regards the production of sustained oscillatory currents, and did not do so even now. He still maintained that nothing had been brought forward to show that his claims were not just.

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THE CATAPHORIC TREATMENT OF CANCER.

By G. Betton Massey, M.D., Philadelphia.

Among the most serious of the many responsibilities of the medical practitioner is the duty thrust upon him at times as the adviser of a patient suffering from the apparent presence of a cancerous growth, and this duty is even graver and more momentous when the morbid growth is so unimportant in appearance as to render its character still doubtful, for it is in the incipient stage that recent scientific investigations have opened wide the door of permanent relief and cure. This being so, what a crime against humanity, his profession, and the welfare of his patient was committed by that physician who outlined his plan of campaign against this terrible affection by the

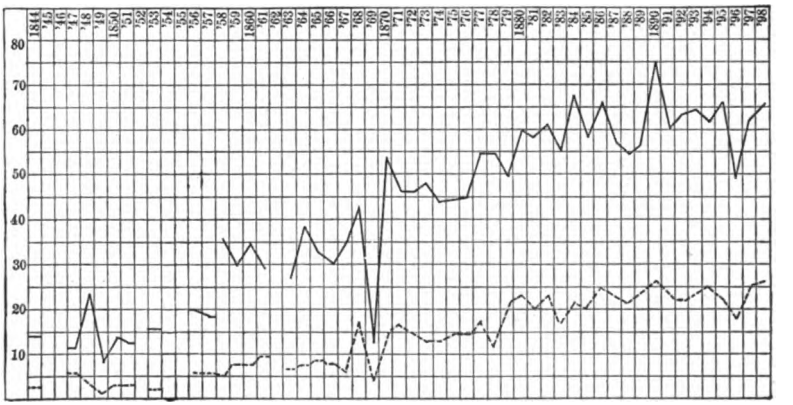

Fig. 1.—Graphic Chart of Cancer-mortality in New Orleans. Representing the mortality-rates of cancer in the city of New Orleans during the fifty-four years, 1844 to 1898, inclusive. The continuous line shows the number of deaths from cancer per 100,000 living persons in the years represented by the vertical spaces. The broken line represents the number of cancer-deaths in each 1000 deaths from all causes in the same years. The figures for some of the earlier years are wanting. (From figures kindly furnished by Dr. Sidney F. Théard, Secretary of the Board of Health, New Orleans.)

dictum: "Never touch a cancer until you have to!" It is, of course, clear that this physician's pessimism was an honest expression of his experience with the conventional operations for the disease, but the "blunder that was worse than a crime" in the formation of the opinion lay in his failure to see that the bad results from the unsuccessful knife operations known to him must have been largely due to the

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tendency to postpone the appeal to the knife or some other similar method, that is only too prevalent already among the people.

The newer facts relating to cancer and allied malignant growths are both discouraging and cheering. The discouraging items relate to the steady increase of cancer in those countries in which a record is kept of the cause of death of decedents. In England and Wales there was an increase from 38 deaths from cancer per 100,000 living population in 1864 to 75 deaths from the disease in the same population-rate in 1895. Other European countries report similar increases in the cancer-mortality, while in America the statistics compiled recently by the writer have proved that this dreaded disease is increasing in frequency at a rate nearly equal to that found in older countries.

The American statistics compiled by the writer consisted of the

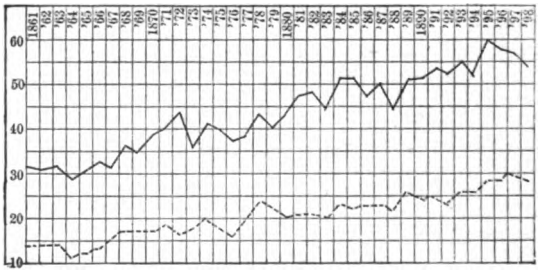

Fig. 2.—Cancer-mortality in Philadelphia. Representing the mortality-rates of cancer in Philadelphia during the thirty-nine years, 1861 to 1898, inclusive. (From figures kindly compiled by Mr. J. V. P. Turner, Registration Clerk of Board of Health, Philadelphia.)

rate of mortality from cancer found in the records of the health offices of seven of our large cities, extending back some thirty or forty years, and were published, illustrated by the accompanying charts, in the *American Journal of the Medical Sciences* for February, 1900. The records of each city, the only accurate figures of the kind to be obtained in this country, were brought down to the year 1898. The figures show that the cancer-mortality of St. Louis had increased from 12.8 to 47.6 per 100,000 population in thirty-one years.

In Philadelphia the increase was from 31.7 to 56.6 deaths from cancer per 100,000 population in thirty-seven years.

In New York the increase was from 35 to 58.3 in thirty-two years.

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In Baltimore the increase was from 17.5 to 61.1 in twenty-eight years.

In New Orleans the increase was from 13.9 to 64.3 in fifty-four years.

In Boston the increase was from 27.9 to 76 in thirty-five years.

And in San Francisco the figures showed the immense increase from 16.5 to 103.6 in thirty-two years.

Taken together, the seven cities showed an increase from 35.4 to 66.4 cancer deaths per 100,000 living population in the twenty-eight years ending in 1898.

It is therefore evident that cancerous diseases have doubled in

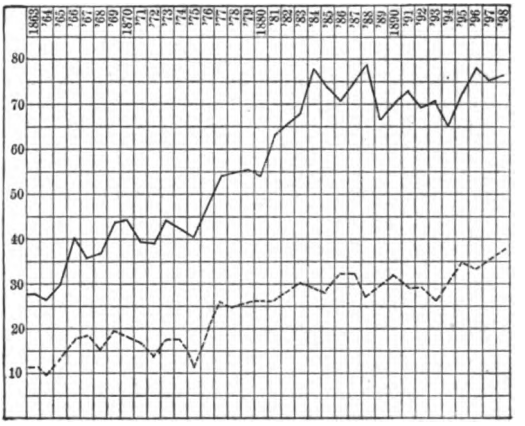

Fig. 3.—Cancer-mortality in Boston. Representing the mortality-rates of cancer in Boston during the thirty-five years, 1863 to 1898, inclusive. (From figures kindly furnished by the Registrar of the Board of Health, Boston.)

frequency in American cities, by a steady annual increment, during the life-time of the present generation. What the increase has been in the rural communities can only be conjectured, owing to the absence of records, but it is extremely probable that these affections are more prevalent in the country than in cities.

The brighter side of this sad revelation is the stimulus given by it to a further study of a disease that has never been thoroughly understood in its etiological and pathological characters. The efforts of European bacteriologists to find the germ that a reasonable hypothesis insists must be the active cause have been supplemented by the establishment of a state laboratory by the State of New York for researches

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in this direction. An organism said to be this germ has been isolated by a number of investigators, and its character variously stated as a blastomycetis, or yeast-like plant of the lower vegetable kingdom, and as a protozoön, or amœbiform representative of the lower animal kingdom; but whence it comes and how it gains access into the human tissues are yet unsolved mysteries.

The facts already ascertained are, however, sufficient to take cancer and sarcoma out of the classification of constitutional diseases and to place them in the list of local infections. To do so at once lifts them from the position of hopeless visitations of Providence into the plane of practical therapeutics, for by this conception of the disease it is as reasonable to expect that an early local invasion of the germs can be as effectually stamped out at its point of origin in the human

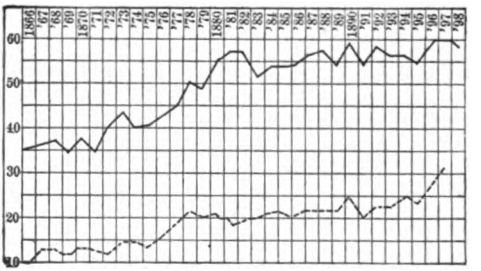

Fig. 4.—Cancer-mortality in New York City. Representing the mortality-rates of cancer in New York City during the thirty-two years, 1866 to 1898, inclusive. (From figures kindly furnished by Dr. Roger S. Tracy, Registrar of Records, New York City.)

body, if accessible, as that an analogous process will arrest an invasion of the bubonic plague in one of our ports. The importance of a more general recognition of this truth among the people (and possibly even among the medical profession) is very great, and on it centres all the hope we have at present that this insidious epidemic will be stayed.

It is beyond the scope of this paper to dwell upon the stages by which a purely local carcinoma or sarcoma, if neglected, becomes disseminated throughout the region surrounding it, the former quickly infecting the lymphatic glands through which the region is drained, and the latter continuing its erosive course directly along muscular and fascial sheaths; but in either case the malignant colony remains absolutely localized until the infected cells reach the circulation, resulting in the growth of daughter-tumors wherever the cells are

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mechanically arrested in the capillaries; and it is in this latter stage alone, found—unfortunately too often—in neglectful patients, that the stamping-out process is no longer possible.

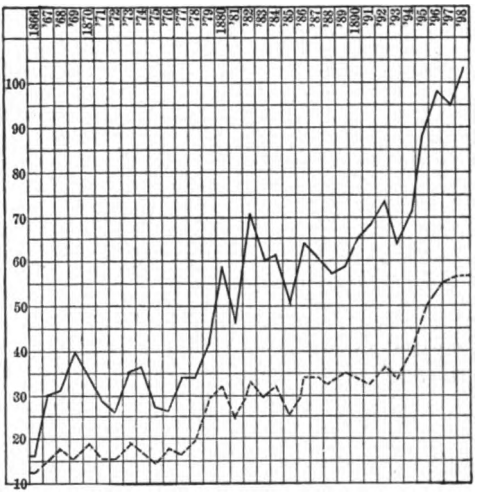

Fig. 5.—Cancer-mortality in San Francisco. Representing the mortality-rates of cancer in San Francisco during the thirty-two years, 1866 to 1898, inclusive. (From figures kindly furnished by Dr. W. H. Griffin, Health Department, San Francisco.)

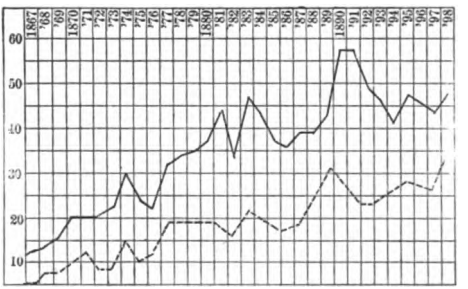

Fig. 6.—Cancer-mortality in St. Louis. Representing the mortality-rates of cancer in St. Louis during the thirty-one years, 1867 to 1898, inclusive. (From figures kindly furnished by Dr. Max P. Starkloff, Health Commissioner, St. Louis.)

Local and thorough removal or destruction of the germs of the disease, including all infected cells wherever situated, being the only method of treatment yet known, it is evident that its success is directly

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proportional to the accessibility of the growth, to the earliness of treatment, and to the possibility of removing all infected cells of the primary growth and outlying colonies. The time-honored mode of

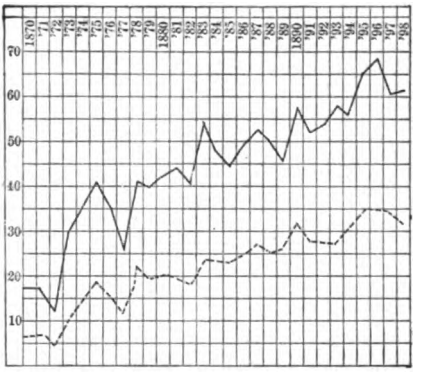

Fig. 7.—Cancer-mortality in Baltimore. Representing the mortality-rates of cancer in Baltimore during the twenty-eight years, 1870 to 1898, inclusive. (From figures kindly furnished by Dr. A. K. Hadel, Health Department, Baltimore.)

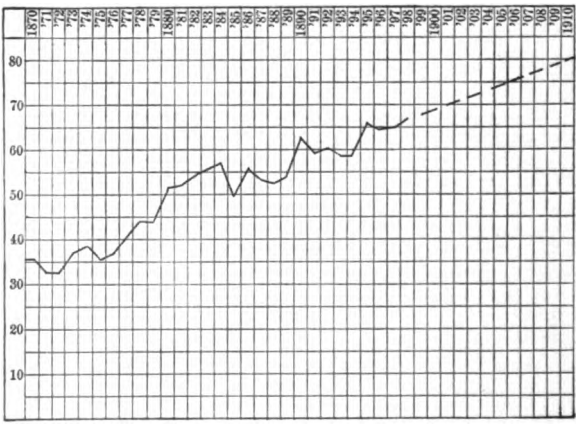

Fig. 8.—Combined Cancer-mortality of Seven American Cities. Representing the combined ratios of cancer-deaths per 100,000 living population shown in the preceding seven charts, to which is added a broken line showing the probable rate of increase until the year 1910.

removal of the infected organ by the knife remains, in some instances, the best and quickest method of removing the disease, particularly

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since the recent improvements which include the excision of large portions of the surrounding tissues; yet the knife is said to have the disadvantage of at times implanting the still-living cells in the freshly-cut edges of the wound.

A method which will kill all infected cells at once, *in situ*, is, in some respects, a distinct advance upon the cutting operation. Such a method is that of cataphoric destruction by nascent salts of mercury, discovered and introduced by the author between the years 1893 and 1897, and since elaborated in a number of communications to medical societies and journals. By the electrical conversion of metallic mercury injected into the growth into a soluble oxychloride, which is then diffused in all directions through the growth, the protoplasm of the cells, germs and all, is converted into a dead albuminate

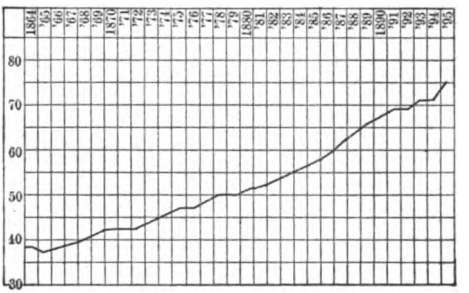

Fig. 9.—Cancer-mortality in England and Wales. Representing the rate of cancer-mortality per 100,000 living persons in England and Wales during the thirty-one years, 1864 to 1895, inclusive. (From the figures given by the Registrar-General, England.)

of mercury, rendering the dead mass thus formed aseptic and odorless until it drops off, leaving a clean wound to be healed by granulation. But the method does not stop its usefulness at the edges of the slough thus formed. This *area of destruction*, which should be coterminous with the supposed edges of the growth, is surrounded by a *zone of sterilization* of varying extent, within which the diminishing density of the radiated chemical leads to the death of the lowly-organized cancer-cells only, the normal tissues being merely stimulated to a greater physiological resistance.

The application which is designed to accomplish these results requires a current of from 300 to 800 milliampères, lasting from half

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an hour to two hours, in accordance with the extent of the growth, and is made under cocaine or general anæsthesia. The tumor becomes lead colored, dry, and odorless (if in the stage in which odor exists), and the subsequent progress of the case is unattended by pain.

The chief advantages of this method, the technical details of which are fully stated below, are:—

1. It is capable of removing many growths as thoroughly as the knife, and yet bloodlessly, thus being adapted to situations where vascularity is great, and conserving the strength of the patient, who is frequently weakened by the loss of blood attending removal by the knife or curette.

2. It affords no risk of autoinoculation of germs, as all germs are killed at once by the diffused microbicide.

3. The diffused chemicals sterilize a considerable area beyond the apparent limits of the disease, the chemicals tending to be forced along the paths of cancer prolongation by preference on account of the increased conductivity of the cellular lines of proliferation, thus apparently exercising a selective influence upon the so-called roots of the cancer. A true selective action also results from the fact that cancer-cells succumb more quickly to the diffused chemical than normal cells.

4. By reason of the fact that the zone of sterilization may be made to extend an inch or more beyond the limits of the growth without harm to the normal tissues, this method is capable of eradicating a small cancerous growth within an organ—such, for instance, as the breast—without destruction of the remainder of the organ.

5. The cataphoric method permits the operator to confine the destructive process to one or more glands that may be secondarily affected within the region in which the primary growth exists (if not too deeply situated), the diseased glands only being destroyed at will, bloodlessly, thus saving the unaffected glands as a protection to the patient from internal dissemination should local recurrence supervene.

6. The method offers the most practical and speedy process for the destruction of early local recurrences after the knife operation, if internal dissemination has not occurred, small subdermic growths within the course of lymphatic vessels being even removable under the local application of cocaine or eucaine.

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How the Method Was Discovered.

During the summer of 1893 the author attempted the electrolytic destruction of an adenocarcinoma of the groin in a gentleman, employing at first the ordinary bipolar method, and subsequently positive cauterization with a blunt electrode of carbon. Slow progress was being made with currents of 100 milliampères under cocaine anæsthesia, when it was noticed that the carbon electrode showed signs of roughening under the repeated attacks of the nascent oxygen and chlorine liberated by the electrolysis. It now occurred to him that a zinc electrode would be better, since the chlorine and oxygen would unite with the eroded zinc and form an oxychloride which would greatly assist in the caustic process. This had been either done or suggested by a number of other students of cataphoresis, particularly Gautier, of France, and Morton, of New York. A suitable instrument was accordingly fashioned from a Leclanché zinc and applied, without any appreciable change in the effect with the relatively-small current used. As, however, the active surface of the zinc was found to be blackened and roughened by the formation of oxides of the contained ferric impurities of the commercial zinc used, it now occurred to the writer that a free amalgamation of the zinc with mercury would be of the same value here as when the zinc is employed within a battery: *i.e.*, to keep it clean by reason of being coated with a layer of pure zinc in mercuric solution. The thought also arose, but distinctly secondarily, that possibly the mercury could also be chemically changed and diffused with the zinc. The experiment was accordingly made at once, and with 100 milliampères turned on there soon appeared a whitish pellicle beneath and around the instrument, distinctly different from that produced previously by the zinc alone. The next day the importance of the discovery thus made was evident when it was noticed that the unpleasant odor that had issued from the wound could no longer be detected, and that the area of induration was lessened on the side on which the application was made.

Such was the initial observation of mercuric cataphoresis, and though mercuric salts were thus diffused locally within the body for the first time by electric currents in conjunction with zinc salts, it was a natural step to proceed later to their diffusion in a pure condition by employing a gold instrument as the active pole, the affinity of gold for mercury being well known, and it being also known that pure gold will not itself become eroded under the action of the most

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powerful current at either pole (though its alloys are quickly dissipated at the positive pole).

Later observation and experiment with the pure mercuric cataphoresis from mercury-holding gold instruments, with the zinc-mercury combination, and with various other erodible metallic electrodes, including metallic arsenic, have resulted in the retention of both pure mercuric cataphoresis and mixed zinc-mercury cataphoresis in various forms of malignant growths in accordance with certain indications, the earlier combination being of value when large masses of carcinomatous or sarcomatous tissues are to be quickly necrosed, the chloride-of-zinc constituent adding greatly to the cauterant action. The difficulty of holding a sufficiency of mercury on gold electrodes in certain situations operates also in favor of the use of the solid-pointed zinc-mercury instruments.

It was early found that any considerable current quickly denuded the gold electrode of its mercury, and in order to maintain a sufficiency of this material in contact with the gold surface for the diffusion of the oxychloride throughout large tumors it became necessary to employ hollow instruments, through the cavity of which an excess of mercury could be injected before and during the application.

Physical Laws Involved in the Method.

When a cancer, tumor, or other portion of the human body is subjected to the action of a direct current electrolytic decomposition occurs, the water-containing tissues being resolved into their simplest chemical elements, the oxygen and chlorine finding its way toward the positive pole and appearing in a free state when actually reaching it, and hydrogen and the bases at the negative pole. Neglecting the present consideration of what occurs at the negative pole, which in this work is robbed of local effect as much as possible by being widely spread out on a distant portion of the skin surface, it will be seen that, when a powerful current is used and the action at the positive pole concentrated within a small area, the effect of ordinary electrolysis at the positive pole is the development of a necrosis of tissue due to the nascent ozone and chlorine; but such only occurs when the electrode itself is proof against these cauterants, as when it consists of platinum, carbon, or gold. When the gold is coated and surrounded with mercury, or when any other metal than platinum, carbon, or iridium is used, the ozone and chlorine attack it instead of the tissues;

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and now the interesting phenomena of cataphoresis occur. The atoms of active oxygen and chlorine having united with the mercury (or other oxidizable metal present), molecules are formed which present an opposite electrical affinity. These now become cathode-seekers instead of anode-seekers, and are forced by the still-flowing current away from the positive pole, radiating along the paths of least resistance toward the distant negative plate.

Thus, a steady, radiating stream of mercury-containing molecules is diffused from the gold-mercury electrode along the most cellular paths leading to the interior and to all sides, the molecules of the oxychloride passing through the interior of all living cells in their path as well as between them, uniting, in fact, with the albumin of the cells to form dead albuminates, with ever-changing atomic partners. As the tissues are thus devitalized, they assume a leaden color, which forms a ready index of the extent of the growth brought under the action of the remedy, and permits the operator to gauge his work accurately. The cancerous tissues lose their hardness also as the devitalization spreads, thus affording another accurate means of gauging the progress of the work.

The distance traversed by these molecules of the oxychloride of mercury depends upon their atomic weight, the potential of the current, and the duration of the application. The exact rates of cataphoric speed of some chemical elements have been accurately ascertained by physicists, but no figures relating to mercury have yet been obtained by the writer. From clinical observation, however, it may be said that 400 milliampères from 160 volts will spread an effective density of the mercuric salt about a half-inch in every ten minutes of the application, enabling the operator effectively to destroy an average growth and sterilize its surroundings in from half an hour to two hours.

Clinical Phenomena During and After the Application.

The whole apparent limits of the growth having been softened and changed into a leaden or grayish eschar, the operation is complete, and the removal of the dead material and of the deposited salts is left to the processes of nature. As a rule, no pain is felt after the patient recovers from the anæsthetic, if one has been used, though a sensation of heat and some soreness persist for several days. If the case presents foul odors from an ulceration the odor will cease during

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the passage of the current and will not return at any time during the reparative process, even though a large eschar be present, on account of the large quantity of the mercuric salts impregnating it.

On examining the site of operation it will be found that the whole of the growth is included in an *area of necrosis*, limited by the extent of the decolorized and softened tissues, at the edge of which a line of demarkation becomes apparent in a few days. Beyond the line of demarkation a puffy, somewhat reddened, zone will gradually develop within a day or so, constituting the *zone of sterilization*, within which enough of the salts have been diffused to kill the cancer-germs without necrosis of the stroma. This zone shades off into the unaffected tissues somewhat irregularly, in accordance with their varying conductibility, the more cellular planes, or those containing the yet-undeveloped colonies of cancer-cells, resulting in the widest extension of the microbicidal agents.

The line of demarkation becomes complete in from seven days to three weeks, in accordance with the lesser or greater amount of fibrous tissue present, when the eschar comes away, leaving a healthy excavation, which speedily fills with normal granulations. During this process there is a considerable flow of a grayish-staining liquid from the edges, which doubtless contains much of the diffused chemical. A small portion of the mercury is evidently absorbed into the general circulation, as evidenced by the characteristic alterative and tonic effects; but in no case has ptyalism, or any other untoward effect, been found.

Illustrative Cases.

During the past eight years the mercury-cataphoric method has been applied by the writer to some thirty-eight cases, all practically unselected, and, though many of these patients were in the advanced stages of the disease, it was thought best by their attending physicians that they should have the benefit of this chance of amelioration or possible cure. The greatest bar to ultimate cure was the subsequent discovery that in a large proportion of the cases, twenty in all, internal dissemination of the disease really existed at the time of the application, being suspected to exist in some and not suspected in others. The amelioration produced in the greater number of these cases was due to the elimination, or the lessened activity, of the primary focus of infection by the application, which thus controlled pain and hæm-

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orrhage and prolonged life without checking the onward progress of the internal deposits. In about eight cases the applications, at that time somewhat experimental, failed to check the progress of the local infection for various reasons, such as the use of poor batteries and insufficient current in the early cases, and in several the choice of the minor method when the major application should have been made. In two cases death ensued during the applications: one, an inoperable carcinoma of the left tonsil in a woman already dying from suffocation from the size and situation of the growth; and the other, a sarcoma as large as a man's fist projecting from the orbit in a child of five years.

Eight cases have stood the test of time as cures, as verified by a recent personal investigation into the after-history and present condition of each. Of these, one has remained well more than six years, one more than five, three more than three years, and three less than three years. These eight cases will be described in full, together with the special details of treatment employed in each:—

CASE I. *Inoperable Sarcoma of Hard and Soft Palates Projecting into Mouth and Threatening Suffocation. Cure, Attested by Seven Years' Health, Following Repeated Mild Applications.*—W. H. L., aged 38, a mechanic, was referred by Drs. Hemminger and Bixler, of Carlisle, Pa., in 1893. Three years before a lump appeared above the left tonsil, which had since increased to the size of a goose-egg, involving the soft and hard palates on that side and so greatly interfering with deglutition that at the time he came under observation liquids alone could be swallowed. Respiration was also most difficult. The clinical history and features proved the growth to be a slowly-growing sarcoma, of probably the spindle-celled variety. An extensive operation had been advised, which he declined.

After some ineffectual efforts to reduce the growth by ordinary bipolar electrolysis, he was placed on the milder method of zinc-mercury cataphoresis, with sharp-pointed electrodes. He was able to bear as much as 35 milliampères with the aid of cocaine, the growth being but slightly sensitive. These applications were made daily for six weeks, when he was sent home with what appeared to be a healthy cavity occupying the site of the tumor, and greatly relieved of all of the distressing symptoms. One year later he returned with a lumpy condition in the scar and was again placed on the treatment for a similar period. There was complete replacement of healthy tissue this time, and he has continued in good health since.

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CASE II. *Inoperable Adenocarcinoma of the Rectum. Apparent Cure After Six Months' Treatment by the Mild Method.*—Mrs. V., aged 50, had been ill for twelve years, the main features of the case being an offensive rectal discharge that resulted in many stools and great impairment of health. There was a history of twenty-five stools per day, of dark color and liquid consistence, and she complained of pain in the left groin. On October 10, 1895, she was placed on the milder applications of the zinc-mercury method, with the hollow bulbous electrode, which was gradually carried higher as improvement resulted, until the highest point of the disease, about eight inches from the anus, was reached. The currents averaged as much as 50 milliampères, being at times greater, this strength being attained by the local use of cocaine solution injected in small quantities to the seat of application through the cavity of the electrode. Under this active treatment the electrode shortly detached fragments of polypoid masses, one of which was kindly examined by Dr. Stengel and pronounced an adenocarcinoma. After six months of this treatment the patient returned to her home so greatly improved that there was but two stools per day, of improved consistence and character. The patient continued well some years after, but her ultimate history is unknown.

CASE III. *Incipient Epithelioma of Os Uteri Cured by Repeated Zinc-Mercuric Applications Without Anæsthesia.*—Mrs. A., aged 49, of Salem, N. J., applied for treatment of nervous prostration in June, 1896. In the examination that was made to determine the cause of her condition, an irregular ulceration was found at the os uteri. The hardened edges and unhealthy appearance of the ulceration led me to suspect epithelioma, and the diagnosis was subsequently verified, after microscopical examination, by the late Prof. Theophilus Parvin, who was independently consulted by the lady and her husband.

The patient was placed on the milder applications of zinc-mercuric cataphoresis, 100 milliampères being employed daily for six weeks. The average duration of each application was six minutes, and the electrode employed was a small zinc olive mounted on an insulated brass shank, the electrode being pressed into the roughened excavation. Owing to the short treatments, no local soreness was developed. At the end of six weeks she was thought to be able to return home and continue the treatment in the office, at intervals of two weeks. The local conditions progressively improved, and at the end of six months she was discharged from further treatment. At the expiration of a year she was again examined by Professor Parvin, who could find no

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trace of the disease. She remains well, at the end of more than four years since the application was made.

The relatively-small current employed in this case was offset by its many repetitions, which were made possible by the fact that no anæsthetic was required, the treatment producing but little pain in the insensitive cervix. It appeared to be a typical mode of treating so incipient a case. Unfortunately, it is but seldom that the physician's attention is called to a case in this early stage, and, in fact, its recognition was but an accident in this instance, as there were no direct symptoms complained of.

CASE IV. *Sarcoma of Upper Maxilla, with Distortion of Bony Plates, Successfully Eradicated by a Combination of Major and Minor Methods of Mercuric Cataphoresis.*—W. O., aged 39, employed in sugar refinery, was first seen October 11, 1897. Three months before his attention had been called to a lump protruding at the site of the upper right bicuspid and adjoining molar, which had previously become loose and fallen out without being decayed. Another tooth had, at this time, also become loosened and was removed by the dentist. He applied successively to surgeons at large hospitals in Philadelphia, who diagnosed sarcoma, and advised removal of the superior maxilla.

Examination showed a firm, purplish tumor protruding into the oral cavity from the space left by the missing teeth. The dimensions of the protruding portion were $1\,^1/_2$ by 1 inches, and that it extended into the antrum was shown by a protrusion of the cheek on the right side of the face and by a *flattening of the arch of the hard palate* on the right side of the vault of the mouth. But little pain was felt, and that only recently. No microscopical examination was made in this case, as it was somewhat inconvenient, and the macroscopical appearance, recent growth, and falling of teeth all indicated malignancy. The clinical diagnosis of malignancy was, however, concurred in by Drs. E. P. Bernardy and John Lindsay, who were present at the application, as well as by the well-known surgeons who had previously examined the patient.

On October 27, 1897, the patient was placed under ether, and a gold-mercuric application of 350 milliampères made for fourteen minutes. The application was then discontinued, as the electrodes were found to be too short to permit the lip to be properly protected from the action. The next day about one-half of the tumor was found to be devitalized, the area of necrosis extending, however, well up into the antral portion of the growth. During the following two weeks

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the sloughs, which were inodorous, came away in fragments, painlessly. It was now found that the remaining portion of the growth, being, of course, insensitive originally, would permit of a local zinc-mercury application of 20 to 35 milliampères under cocaine. These were begun in the office, therefore, and continued thrice weekly for two months, when, all diseased tissue appearing to have been destroyed, the applications were discontinued, leaving an opening leading into the antrum with healthy edges. This very nearly closed during the following two or three months.

One year later, November, 1898, the patient returned with some evidence of diseased tissues at the edge and within the sinus, which still remained patent. A few additional zinc-mercury applications were now made to the diseased spots.

At the present time, more than three years after the original application and two years after the second, he is in perfect health, the sinus having finally closed spontaneously.

CASE V. *Recurrent Carcinoma of Breast and Axilla after Removal by the Knife, Eradicated by Gold- and Zinc- Mercury Applications.*—Mrs. B., aged 63, applied for treatment on November 30, 1897, with a recurrent carcinoma near the site of a scar made by the removal of the right breast for carcinoma. The knife operation had been skillfully performed ten months before by Dr. Ida E. Richardson, the breast, a portion of the pectoral muscles, and overlying skin having been removed *en masse*, and also an infected gland in the axilla. The microscope showed the removed tumor to be a highly-malignant acinous carcinoma.

Examination showed a confluent mass of nodules, each the size of filberts, in the subdermic and dermic tissues above the scar, evidently in the line of an infected lymphatic plexus leading to the supraclavicular glands. The latter glands, however, showed no sign of having been reached by the diseased cells. At the site of the removed gland in the axilla there was a suspicious induration and enlargement.

On December 11, 1897, with the kind assistance of Drs. Richardson and W. C. Thompson, the patient was etherized and the gold-mercuric method applied by means of three small gold cannulas in as many centres of growth. The current was gradually brought up to 500 milliampères and maintained at this strength for fifteen minutes. Under this the nodules quickly softened, and an efficient zone of sterilization was developed. After the recovery from the ether the

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patient, who was of the highly-nervous type, complained of pain for twenty-four hours, doubtless owed to the reaction in the comparatively-normal surrounding zone, but the subsequent after-stages were comfortable, and separation of the necrosed material and healing were uneventful. The nodule in the axilla was not touched at this time.

In January, 1899, a small nodule the size of a pea near the clavicle, which had been overlooked, was destroyed in one office application with a zinc-mercury needle, 10 milliampères being employed under local use of cocaine.

In August of the same year the axillary nodule, having shown increased growth, was subjected to a major gold-mercury application under ether, 200 milliampères being employed for twenty-five minutes. No further applications have been required.

At the present time the patient is in better health than for many years, periods of three years, and of one and a half years, having elapsed since each locality was treated.

CASE VI. *Carcinoma of Left Sublingual Salivary Gland Followed by Similar Infection of Opposite Gland; Eradication in Two Applications; Second Application on One Side for Recurrence.*—Mrs. S. S., aged 56, was admitted to private hospital December 21, 1897, suffering from a lump under the left side of the tongue. The lump was first noticed six months before, and was then painless, but two months ago it became ulcerated and extremely painful, and now, by reason of pain and foul odor, interferes with deglutition and sleep. Examination shows a cavity, surrounded by ragged, indurated walls, in the floor of the mouth between the tongue and gum on left side, in dimensions about equal to a hulled walnut. No involvement of lymphatic glands. By an oversight no microscopical examination was made to determine the histological characters, but the clinical evidence of the growth being an adenocarcinoma of the sublingual gland were strong, and were verified subsequently by a recurrence of the disease as a solid growth at the site of the original tumor.

December 28, 1897, the patient was etherized, with the assistance of Dr. S. J. Gittelson, and gold-mercuric cataphoresis, followed by zinc-mercuric, was applied with a current of 350 to 400 milliampères for thirty minutes. During the application the odor ceased (it had previously pervaded the entire house), and after the patient recovered from the ether no pain whatever was felt. These two improved conditions continued during the separation of slough and granulation, and in four weeks she was sent home apparently well.

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June 24, 1899, one and a half years later, evidence of a similar growth appeared on the opposite side of the tongue, the right sublingual gland being infected. A similar application was therefore made on this side at this time.

Six months later, November, 1899, a recurrent growth was found near the scar of the former application on the left side of the tongue. A second application of the same amount and duration was made on the left side of the tongue, and there has been no recurrence since in either spot to the present date, one year later.

CASE VII. *Small Acinous Carcinoma of Right Breast Eradicated in One Application, Without Destruction of Remaining Portion of the Gland.*—Miss B., aged 51, applied for treatment on November 11, 1898, with a painless tumor of irregular outline in the lower outer quadrant of the right breast, that was growing rapidly. Dr. Bruce Burns, of Frankford, Philadelphia, had pronounced it a carcinoma, and advised immediate removal of the breast.

On November 16, 1898, a gold-mercuric application was made under ether, with the assistance of Dr. W. Oakley Hermance, a current of 350 to 475 milliampères being employed for forty minutes. On January 15, 1899, the slough had come away and the parts nicely healed. A peculiar feature of the scar was its linear shape (Fig. 10), in spite of the circular shape of the cavity left at separation of eschar. The patient remains well—in fact, in improved health—at date of publication, two years later.

CASE VIII. *Inoperable Recurrent Carcinoma of Lymphatic Glands of Neck, Following Removal by Knife of Carcinoma of Submaxillary Gland. Probable Cure After One Application.*—Mrs. M., aged 57. The right submaxillary gland had been removed for adenocarcinoma by the late Prof. John Ashhurst, Jr., two years before the patient consulted the writer. The disease had recurred in the neighboring lymphatic glands one year after operation. Examination showed an indurated mass on the right side of the neck below the former site of operation about the size of a split orange. The patient complained of burning pain in the tumor and earache, and was in poor general health.

June 23, 1899, a mixed gold-and-zinc mercuric application was made under ether, assisted by Dr. Hermance and in the presence of Drs. Alvah M. Davis, of Philadelphia, and E. M. Mullins, of Massachusetts. From 300 to 400 milliampères were used for fifty minutes, the latter current-strength being all that the near proximity of the pneumogastric and phrenic nerves permitted without weakening of

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respiration and heart-action. The convalescence followed the usual course, including alleviation of pain and earache, though much tenderness persisted until healing occurred.

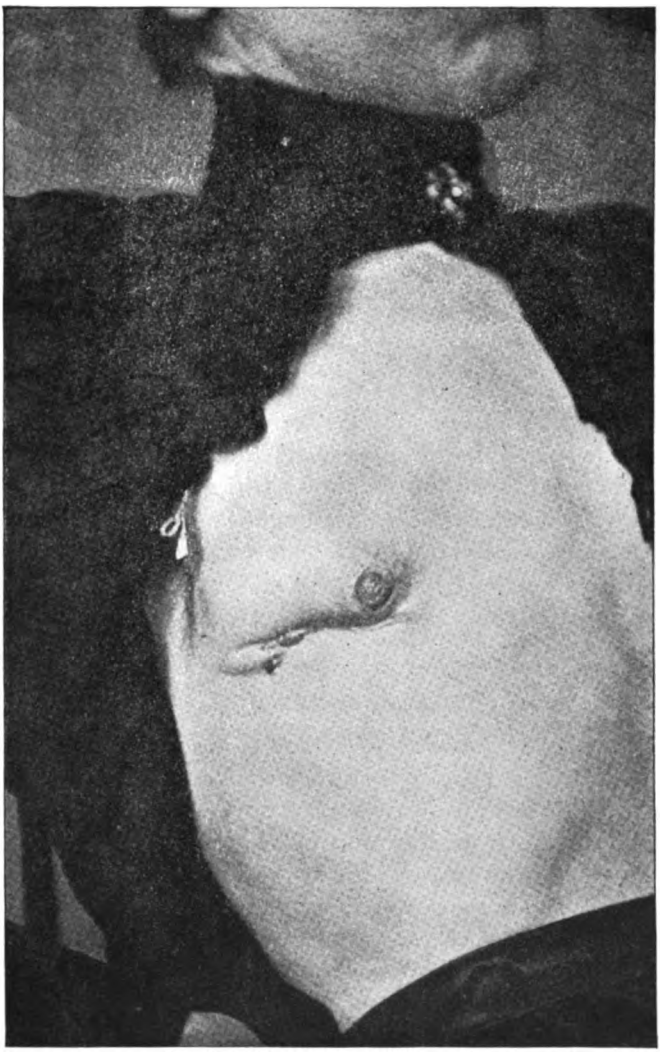

Fig. 10.—Photograph of Scar Left by Treatment (Case VII).

By November 1, 1899, parts were well healed except for some tumefaction below scar.

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In June, 1900, the patient was seen, apparently doing well, though her general health continues poor.

CASE IX. *Recurrent Carcinoma of the Cheek. Eradication by One Combined Gold-and-Zinc Mercuric Application.*—G. W. B., a carpenter, aged 59, applied for treatment on September 17, 1900. The patient has an immense scar on the left side of the nose and cheek resulting from a destruction of a malignant growth of the face by caustics six years before. As a result of this application a large opening exists leading into the nasal cavity.

Examination showed the scar healthy in all portions except at the lowest angle, near and below the outer angle of the mouth, where a focus of growth exists with an ulceration on the buccal aspect. The diseased tissue is about the size of a five-cent piece.

On September 23, 1900, application of gold-and-zinc mercury cataphoresis was made under ether, assisted by Dr. Hermance. The curved zinc was used, owing to the difficulty of keeping mercury in contact with the gold instrument. The application was made from the inner side by means of insulated electrodes, with a current-strength of 250 milliampères for thirty minutes. Owing to the nearness of the induration to the skin surface, a portion of the latter was included in the area of necrosis, resulting in a temporary salivary fistula during the healing process. At the end of a month the sinus closed spontaneously. Site of application remains healthy to date, with evidence of permanent cure.

OPERATIVE DETAILS.

The varying malignancy or extent of cases in which mercuric cataphoresis may be effective naturally divides the applications into two classes with considerable variation in the technical details, depending on whether a small current under cocaine will be effective, or a large current under ether required. The former may be called the *minor method*, and is applicable to very small growths of any degree of malignancy and larger growths of moderate malignancy, the latter being illustrated by certain sarcomas and by rodent cancer (epithelioma of the short hair-follicles of the face).

MINOR METHOD.—The details of the minor method do not differ from any ordinary monopolar electrolytic application except in the material of the active needle, which is, of course, always connected with the positive pole. The negative pole is any pad of sufficient dimensions to act as an effective dispersing pole. Actual puncture of

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the growth is practically essential, as it seems to be necessary for the lethal chemicals to be dispersed directly through the cellular mass. For this method fine gold cannulas may be used, but as good results will, at times, be gained by the employment of the mixed cataphoresis of zinc and mercury, and these electrodes may be made afresh for each application by cutting a sliver from a piece of thin sheet zinc, such as is used under stoves. This sliver should be about three inches long, a few lines wide at the inactive end, and tapering to a fine point. The best conductor to attach to it is a suitable length of fine magnet wire (No. 26 covered copper wire), as a heavy cord will drag on the electrode, increasing the pain of the application. This wire may be firmly attached by simply twisting it about the blunt end of the sliver, which is then bent over and clamped on the wire by a pair of pliers. As they become brittle under use, a new one is usually required at each *séance.*

The point of this small electrode is dipped in an acid and then into mercury, and may be asepticized by a brief heating over the flame of a Bunsen burner or alcohol-lamp. Everything being arranged, with the patient preferably recumbent on a couch, the zinc-mercury point is thrust about a quarter of an inch into the growth, a drop of 20-per-cent. cocaine allowed to fall on the site of puncture, and a current of from 2 to 15 milliampères is turned on very gradually. In a few minutes a whitish area appears at the site of puncture, which gradually spreads radially, producing what will become a tiny area of necrosis. By the end of a quarter of an hour a slight zone of sterilization and reaction appears at a greater distance. Under frequent applications this zone of sterilization becomes quite extensive, the molecules of oxychloride deposited in the tissues by previous applications seeming to be started afresh from their temporary resting-places.

The applications are repeated daily until all diseased tissue has been destroyed, when it will be noted that the surrounding healthy parts have crowded in, finally taking the place of the destroyed cells. In one case treated in this way, a rodent cancer of the face, which was originally as large as two silver dollars, the resulting scar was linear, and occupied a mere fraction of the diseased area, which had been filled in with healthy skin.

MAJOR METHOD.—*Source of Current.*—The street-mains of an Edison incandescent current may be used, but the writer's work has been done with two or three thirty-cell batteries of the zinc-carbon-

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acid variety, coupled in series, giving a combined pressure of 120 volts with sixty cells, or 180 volts with eighty cells (the latter number having been obtained from three batteries: two of thirty cells and one of twenty). Such a battery-force is essential, as the meter-reading at the height of the application must be from 350 to 800 milliampères in the monopolar method, and may be as high as 1200 milliampères when both electrodes are within the growth. The batteries must be in the best condition to sustain this current, freshly cleaned, reamalgamated if bisulphate of mercury is not used in the solution, and always freshly charged. The ordinary portable

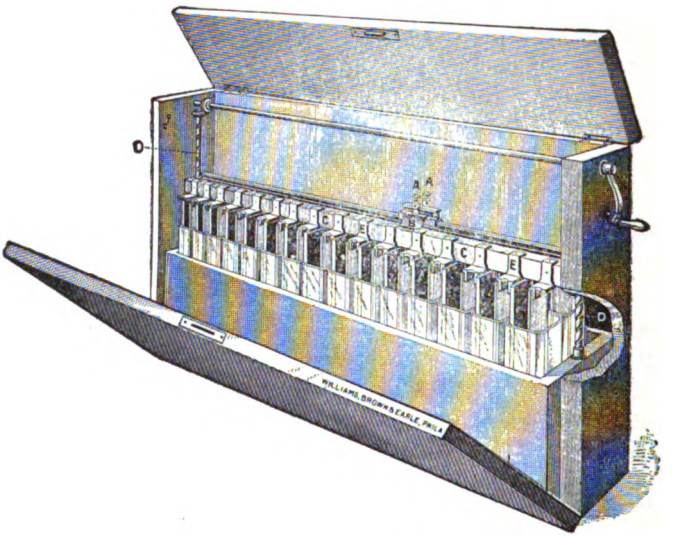

Fig. 11.—Massey Transportable Battery.

galvanic batteries have too small a cell to maintain the higher currents during a prolonged application, and I have therefore devised a battery pictured in Fig. 11, with larger cells and better mechanism, two of which, of 30 cells each, will ordinarily be sufficient. The two batteries are placed in series by connecting with a piece of wire the negative pole of the first with the positive pole of the second, when the positive pole of the first battery and the negative pole of the second will be the actual poles of the combination. Cords or wires from these are carried to the appropriately-marked binding-posts of the controller.

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The Controller.—The best controller for this purpose is an enlarged graphite shunt-controller, made specially for this work by the McIntosh Company, of Chicago. From the binding-post in the patient's circuit of this instrument, marked *N*, a wire is carried to the dispersing plate, and from that marked *P*, one to the meter.

The Meter.—The Weston meter is preferable for this work, as assuring the greatest accuracy. This company makes a special meter with readings to 2000 milliampères for the higher currents. The wire from the post marked *P* of controller is attached to the binding-post of meter marked +. To the other binding-post of the meter the cord leading to the active electrode is attached.

The Dispersing Pad.—To conduct these large currents through the skin at the indifferent pole a very large pad is required. This consists of a thin lead plate 12 by 20 inches in size, or about the dimensions of the patient's back, with a binding-post attached to one side. This is placed on the operating couch (a spring cot covered with rubber sheeting being the best for this purpose, the springs keeping the pad in contact with the skin) and on it is placed a thick pad of absorbent material made of nine or ten thicknesses of Marseilles spread or similar material, thoroughly wetted with warm salt-water. On this the patient reclines when everything is in readiness. The cotton pad should extend well over the edges of the lead plate.

Active Electrodes.—The shape, and to some extent the material, of the active electrode depend on the situation of the growth. In all external carcinomas and sarcomas the gold-mercury method is easily applied, but it is extremely difficult to keep the mercury in contact with the gold instrument in applications within cavities, such as the mouth, vagina, and rectum. Here we must at times be content with the zinc-mercury method, as a small amount of mercury on the surface of the zinc point will supply a large quantity of the mixed oxychlorides of both metals; and though the lessened mercury employed is probably a disadvantage, the mixed electrolytic salts are really more destructive of tissue, rendering smaller currents effective in the production of the area of necrosis at least. The zinc-mercury application affording a lodgment for the mercury may be supplemented by a gold-mercury electrode later in the same application.

The perfected form of tubular gold-puncture electrodes is shown by Nos. 1 to 3 in Fig. 12. The largest size is intended for all cases in which the gold-mercury method is feasible, but, owing to the necessity for several sizes in smaller tumors, it is made in a set of

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three sizes. They are constructed of an inner tube of platinum running the full length of the instrument. Over this the gold tube is shrunken at the active end, while the remainder of the platinum tube is covered with silver to give greater rigidity.[1] Before use the whole of the instrument is insulated with melted gum-shellac or hard rubber, fused on, except the active end. At the distal end of

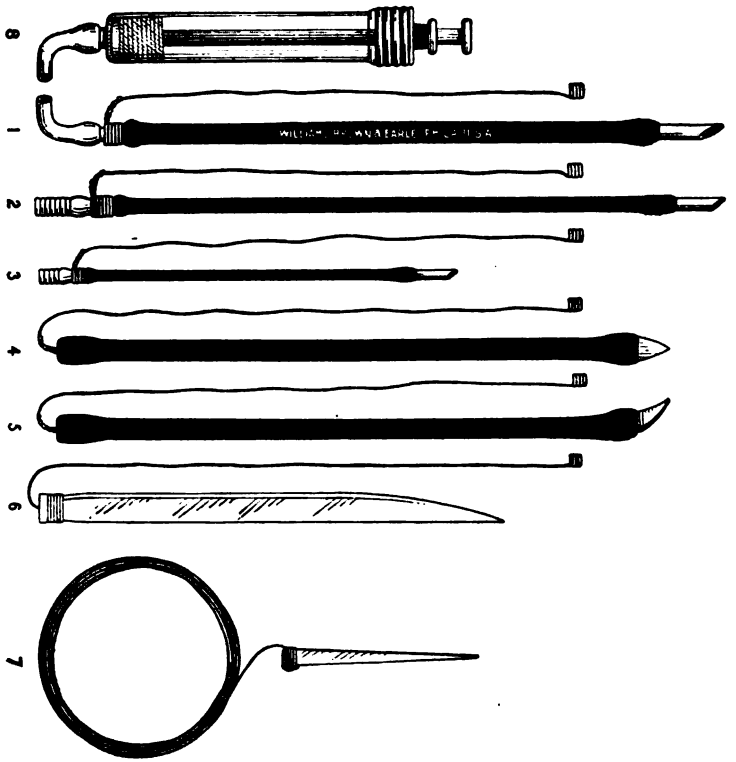

Fig. 12.—Gold and Zinc Puncture Electrodes.

the cannula a rubber tube is attached for the injection of the mercury, and a wire is also affixed by twisting to a bare portion of this end, terminating in a friction-socket for the conducting cord.

For application of the gold-mercury method to the cervix uteri in mild cases of incipient carcinoma, or to rectal cancer when pointed

[1] This instrument, with or without a complete outfit for this work, is supplied by Williams, Brown & Earle, 918 Chestnut Street, Philadelphia.

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instruments cannot be used, the tubular bulbous gold electrode has been devised (Fig. 13).

All gold-mercury instruments must be made of solid, 18-carat gold, the mercury quickly extracting most of the alloy; and they should be freed from mercury after use by heating over a Bunsen burner or alcohol-flame to avoid breakage.

When preparing for an application, the active surface should be sterilized in the flame and then recoated with mercury by dipping in weak sulphuric acid and rubbing the metal in, the process being more tedious than when amalgamating zinc. The portion of the hard-rubber insulation next the point should be renewed usually at this time also, as the chemical action and heat developed at the point of application is often great enough to impair its qualities.

The zinc-mercury instruments are of various shapes, in accord-

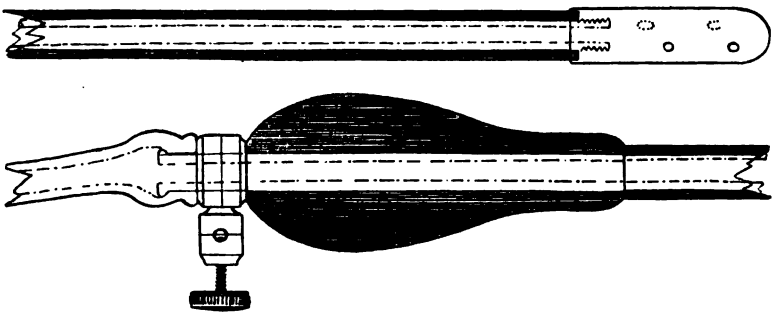

Fig. 13.—Hollow Bulbous Gold Electrode.

ance with their special uses. Those intended for cavities should be as carefully insulated as the gold electrodes, and all should be freshly amalgamated with mercury before each application.

Preliminary Details.—Before etherization is begun the batteries should be placed conveniently and examined to see that all parts are correct, the controller and meter should be placed on a small table in good view of the operator, and the whole connected up as before described and tested for current and correct polarity. Arranged on an aseptic tray on a convenient table there should be a small bistoury for making incisions when necessary for insertion of the electrode; all active electrodes needed in the case, thoroughly amalgamated and freshly insulated; and a small glass syringe fitting the rubber tube on the active electrode, filled with quicksilver. An additional supply of the latter should be placed in a dish on the tray.

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Assistants.—Besides the etherizer, the operator will need an assistant to manage the controller exclusively and another to inject the mercury, note the pulse, etc., the operator himself being sufficiently employed in the management of the electrodes and in noting the current-strength and its effects.

The Application.—The patient having been etherized on the couch with its pad in place and lying on the latter, or placed on the pad after etherization, the indifferent pad should be examined and pressed close to the body, the patient being so disposed as to bring the pad against the lower portion of the trunk. This results in lessening the amount of current traversing the respiratory and cardiac regions. No portion of the metal plate should be allowed to touch the body.

With a narrow bistoury a slit should be made in the tumor, if necessary, in an appropriate spot, near, but not too close to, its base, for the principal action is downward. In hæmorrhagic tumors no bistoury will usually be required to insert the electrode, and even the slight bleeding of a cut may be avoided by temporarily reversing the connections and making the electrode negative, when the instrument will slip in easily; but if the latter procedure be adopted care should be observed to turn the current off at once and make the active electrode again positive before proceeding with the application. In any case the slit should be only large enough to admit the electrode, and should not permit the escape of the mercury after it is injected.

Having inserted the electrode, and noted that its polarity is positive, the tip of the glass syringe should be inserted into the tube of the electrode and a small quantity of mercury forced into the tumor. The necessity for an excess of the mercury lies in the rapid dissipation of the portion adhering to the gold surface under a strong current, and, unless an abundance of the fluid metal remains in electrical contact with the gold surface during the passage of the current, a mere positive cauterization will result. In some cases it is necessary to inject the mercury with slight force and hold it within the electrode by the spring clip. Should the duration of the application be more than a quarter of an hour additional quantities of mercury may be injected without interference with the current.

The Current-strength and Current-duration.—The strength of the current and its duration depend entirely on the extent of the growth. The writer's applications under ether have thus far varied between 350 and 800 milliampères by the regular monopolar method.

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though as many as 1500 milliampères have been used with both poles within, or one within and the other directly on, the tumor. Four or five hundred is the rule in monopolar work, and this strength will take some time to be reached without affecting the heart or respiration if about the head or neck, and is to be very gradually turned on, and turned down if the pulse or respiration weakens, being turned on again after the restoration of a normal force. If the growth is situated below the neck or left breast less care is required, and the duration of the *séance* may be lessened by employing an increased current-bulk.

The time-element is, however, important, even when heavy currents are used, as there is a definite speed for the cataphoric flow of mercuric molecules which has not yet been accurately measured, though I have grossly determined that the speed attained in these applications is about half an inch in ten minutes. To reach well out into the zone of sterilization that will be necessary in a given case will, therefore, usually require several times this duration in a given spot, making the total duration of the application in several spots, if the electrode has to be shifted, from one to one and a half hours, or even two hours in large growths near vital organs. The *amount* of oxychloride transferred will depend on the volume of the current, and this must be great when a large area of necrosis is to be produced, but *no increase of current will make up for lack of penetration of the mercuric atoms due to insufficient duration.*

It should be the aim of the operator to secure complete results at the first application, though a second application can be made some weeks later if necessary, if this aim has not been accomplished.

Immediate Results.—Within a few moments after an adequate current has been turned on a whitish-gray color will appear in the tumor in immediate contact with the electrode, which progressively increases in area, radiating in all directions from the electrode. As the area of necrosis becomes greater, and finally includes the whole of the apparent limits of the tumor, it will be noticed that the brawny induration of the growth gives place to a softer and more doughy condition, corresponding undoubtedly with the loss of tone accompanying the loss of vitality in the malignant cells. This progressive softening of a hard growth is a remarkable phenomenon, particularly when it is remembered that the normal effect of the positive pole is desiccating, and therefore somewhat indurating in soft tissues.

As the area of necrosis becomes nearly coterminous with the

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growth the latter is seen to become smaller as well as softer, this last effect being most easily explained by the physical loss of fluids driven from the growth by the cataphoric action.

Having decided that the area of necrosis is sufficiently extensive to include all apparent portions of the growth, the current is turned off gradually and the patient put to bed. The time required to secure this result will naturally depend upon the size of the growth and the strength of the current that is possible in its particular situation. It has varied in my cases from fifteen minutes to two hours and a half, in the latter case etherization having been prolonged with as little ether as possible. The immediate effects on the color and consistence of the tumor have been mentioned, but it should be added that, if the cancer has become ulcerated and foul smelling, all odor will disappear during the application by reason of the highly-antiseptic action of the electrolytic salts developed, and the amount of these that have been interstitially deposited will protect the slough that will form from subsequent decomposition during the time required for its separation. Within a time varying from one week to three weeks the line of demarkation will have fully formed, and the eschar will come away, leaving a clean and healthy cavity to be filled up by granulations. Beyond the line of demarkation a zone will be noticed radiating to a greater distance, which becomes puffy and somewhat swollen during the twenty-four hours subsequent to the application. This irritation is evidence that the zone of sterilization has been effectively formed, and that the latent cells beyond the apparent limits of the growth have been killed. The swelling quickly subsides and the absence of malignant characters in this situation during the healing process is evidence of successful application, and *vice versâ*. On the appearance of any evidence of doubt on this point a second application should be resorted to at once.

The effect of the application on a painful case is also noticeable. When the patient recovers from the ether there will only be a treatment tenderness remaining, all neuralgic pains having ceased, and the healing process is usually quite free from pain.

DISCUSSION.

DR. W. J. MORTON said that the association should not allow this paper to pass without at least expressing approval of Dr. Massey's work. He wished to congratulate him on carrying forward this method so courageously. It was well known that Gautier had introduced metallic electrolysis and had treated

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cases of lupus, etc. Dr. Morton said that he had been one of the first in this country to treat cases with metallic electrolysis, using different metals. Reasonable success had been met with under this method, but he was frank to say that he had never felt like using such heavy currents. If by any inadvertence the patient moved, there would be a variation of potential, and it must be remembered that the variation of only 2 milliampères about the head would produce severe vertigo. He had known 25 milliampères to produce a momentary syncope. It was interesting, therefore, to note the heavy currents employed by Dr. Massey about the head, and it would be interesting to know whether syncope would have occurred if the patient had not been etherized. Dr. Morton said he had been somewhat disappointed with metallic electrolysis, because, on experimenting with meat, and examining it afterward with the microscope, he had found that with a current of from 50 to 75 milliampères the diffusion of the metal was decidedly limited. For this reason it seemed to him better, in many cases, to use the knife than to make many applications of metallic electrolysis. Undoubtedly Dr. Massey's method might be useful in certain inoperable cases of cancer. He wished again to congratulate Dr. Massey on his treatment, which reminded him of the heroic methods of Inglis Parsons, of England.

Dr. Rockwell said that many years ago he had studied and experimented with the electrical treatment of cancer, and had demonstrated pretty thoroughly that very little could be done for cancer by the electrolytic method alone. He had then adopted the plan of having the tumor removed, and then "worked up the base" by electricity. This also proved disappointing. He would suggest to Dr. Massey that it might be well to follow this last method in a large cancerous tumor, introducing the mercury into the base, thus diminishing the amount of sloughing.

Dr. Morton said that, when these metals are oxidized at the positive pole, it is at the expense of the electrolyte, and as soon as the tissue becomes dry—in other words, deficient in the water furnishing the oxygen—the electrolysis goes on slowly, because the electrolyte has been exhausted. To obviate this, he had been in the habit of using a hollow platinum needle, with the aid of which he injected a solution of chloride of sodium, thus adding fresh electrolytic material.

Dr. S. Fairweather Wilson, of Montreal, asked Dr. Massey if he had published any tabulated record of his cases, giving information as to the location of the growths, and as to whether in all of them microscopical examinations had been made to verify the diagnosis of cancer. He would also like to know whether this treatment had been tried upon uterine cancer, and how he could prevent the current from destroying the normal as well as the abnormal tissues, particularly where the tissues are out of sight.

Dr. Massey, in closing, urged, as an additional advantage of the method, that cancer of an organ could be extirpated without removing all of the organ. One of the two fatal cases, he said, had been that of large sarcoma projecting fully six inches from the orbit in a child of five years. Death had occurred on the table. The other death was in the case of a large carcinoma of the tonsil, and was from suffocation. In these etherized patients syncope amounts to nothing; the chief danger was from interference with respiration or with the

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heart's action. The operator was justified, however, in taking some risk in these desperate cases of cancer; the disease is terrible and the present methods of treatment are inadequate. The method suggested by Dr. Rockwell would probably be a good one in many cases, except that the bleeding would interfere somewhat. Microscopical examination had been omitted in some cases of recurrence, when the recurrence itself established the diagnosis, but, as a rule, such an examination had been made. By changing the position of the electrode from time to time one would overcome the difficulty arising from the exhaustion of the electrolyte, as described by Dr. Morton. The addition of water to the dried tissue did not help; hence he would be glad to try the plan of supplying a solution of chloride of sodium. Nearly all of his cases were published last spring in the *New York Medical Journal*. This list included some uterine cases. The method was particularly suitable in cases of carcinoma of the cervix, for the work could be carried on readily in a deep cavity. The application should be continued until the cancer became soft to the touch.

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THE CAUSE OF SOME CASES OF NEURASTHENIA, AND THEIR TREATMENT BY ELECTRICITY.

By Francis B. Bishop, M.D., Washington, D. C.

Mr. President: The conglomerate set of nervous symptoms known as neurasthenia, or nerve-weakness, frequently seen in the individual predisposed by an unstable nervous system, may be caused by a variety of morbid conditions, reacting upon the nerve-centres, thereby producing pathological and often degenerate changes in the cells themselves; these changes, according to the centres involved, will give expression to the mental and physical symptoms known as neurasthenia and sometimes epilepsy, hysteria, or perhaps severe neuralgia. Any slight physical derangement—such as severe nervous shock, a uterine disorder, a urethral stricture, or a sensitive prostate—is all that is necessary to fan the slumbering flame.

As has been frequently pointed out by writers upon this subject, neurasthenics are not the physically-weak individuals, as a rule, but many of them seem strong and vigorous, and are usually men and women of the better class, society women and brain-working men, and it is to this class of patients of sedentary habits that I wish, particularly, to refer to-day; and while my investigations may have revealed nothing absolutely new, they have revealed some facts, and facts are always worth recording.

For the past three years it has been my custom, in all cases of neurasthenia coming under my care, to have a quantitative analysis of the urine made before beginning my treatment, and, in nearly every case, I have found the amount of certain solids markedly diminished; especially is this the case in the elimination of urea. The specific gravity is often within the normal limit. The amount of urine passed in twenty-four hours is often below the normal, while the earthy phosphates are always in excess. Thus we have, as a basis for our argument, diminution in the daily quantity of urea eliminated and an excess of phosphates.

Physiologists have given us as a normal standard, with a mixed diet for the twenty-four hours' elimination, about the following: Total amount of urine, 1500 to 1600 cubic centimetres. This should contain about 60 grammes of solids, of which about 35 grammes should be urea, while we have only $3\,^1/_2$ grammes of phosphoric acid with which to form phosphates. Now, as urea or its antecedents, when

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retained in the system, becomes a systemic poison, and often produces sudden death by overpowering the centres of respiration and of the heart, and sometimes produces violent convulsions, it is not unreasonable to conclude, when a very small amount is retained each day (not enough, perhaps, to produce the overpowering influence referred to), that the nerve-centres must show the toxic influence by slighter symptoms, such as we find in neurasthenia and other functional nervous disease.

The muscular tissue forms about 42 per cent. of the body-weight, and contains 75 per cent. of water and 21 per cent. of proteids, or about one-half the proteid material and water contained in the whole body; thus the muscular tissue is the most abundant and the most important tissue of the body, as nitrogenous waste is more abundant in the muscles than in the other tissues, and the final result of this metabolism is urea. After the food has been assimilated and is a part of the body, the theory is that the proteid substances break down to form urea; or, in other words, in the process of metabolism, anabolism, or the building up, and catabolism, or the breaking down, go on perfectly in the healthy individual; and the antecedents of urea, formed of proteids by catabolism very largely in the muscular system, are carried to the glandular system, particularly to the liver, to be converted into urea. But in the individual of sedentary habits and with a good appetite, who uses his brain extensively and his muscles but little, the conditions are liable to be changed; assimilation and anabolism may go on fairly well, but catabolism is diminished, the formation of urea is lessened, and the excretion of urea is, of course, below the normal. On the other hand, the excess of phosphates in the urine shows imperfect anabolism of the brain-cells, an imperfect assimilation of the phosphorized substances in the food, or an excessive catabolism of the brain-cells and nerve-cells. We must here eliminate cases of structural change in the kidneys, for these conditions may, and do, exist without any structural change of the kidneys whatever. The urea is simply not formed, and its antecedents remain in the system to produce vague and numerous nervous symptoms by toxæmia.

An interesting physiological fact is that muscular exercise does not seem to increase the elimination of urea on the day the exercise is taken, but on the following day the increase is marked, showing that, while muscular exercise is most valuable for its elimination, there are certain physical and chemical changes necessary before the

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elimination as urea; therefore the object of our treatment should be to aid as much as possible these changes.

I will give briefly the history of two cases under my care, together with an analysis of the urine in each case. A lady about 40 years of age, and weighing 140 pounds, who had spent the better part of the last five years in a sanitarium, consulted me in consequence of a train of nervous symptoms which, she asserted, she was sure would kill her, or send her to an insane-asylum. Her bowels were obstinately constipated, and when they were moved by medicine or enema she experienced great pain, followed by extreme fatigue and nervousness, accompanied by excessive cardiac palpitation. She slept poorly, and would be awakened by palpitation of the heart. She could think only of herself, could not concentrate her mind sufficiently to read the lightest work of fiction. Her pupils were widely dilated and reflexes all exaggerated. She had formerly taken great pleasure in music, but an attempt to play upon the piano made her very nervous. The presence of those she loved best seemed to irritate her most. Slight exercise caused great fatigue. Her appetite was good. An analysis of her urine revealed the following condition: Total amount in 24 hours, 1350 cubic centimetres. Reaction, sharply acid. Specific gravity (corrected for 70° F.), 1.020. Solids in 24 hours, 63 $^1/_2$ grammes. Urea for 24 hours, 17 grammes. There was no albumin, no sugar, no bile, no inorganic sediments, no casts, while the earthy phosphates were in great excess. Here we have the daily quantity of urine approaching closely to the normal for a woman: normal reaction, specific gravity within the normal limits, with an excess of solids and only about half the daily amount of urea excreted, while the phosphates are in great excess. The weight and general appearance of this lady showed that anabolism was going on, while the amount of urea excreted gave evidence of the fact that the antecedents of urea were retained in the tissues. The phosphates being in excess helped to run the daily amount of solids above the normal. But the most interesting feature of the case is that, as the patient improved, her urea increased and phosphates diminished, until they both reached about the normal, when she was discharged cured.

In these cases pathologists tell us that they find a shrinkage of the cells of the brain-cortex and of the gray matter of the cord, and this seems reasonable, as there seems to be evidence of the fact that there is either a lack of assimilation, by the cells, of the phosphorized

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elements of the food, or perhaps of a decomposition of the phosphoric acid in the nucleus of the cells themselves, and these weakened centres receive and transmit false impressions, giving us the varied symptoms, both physical and mental, that we find in this peculiar, nervous malady.

The next case is that of a gentleman weighing 230 pounds who also thought that he was headed straight for the asylum. In fact, when he was introduced to me, before I could speak, he threw both arms around my neck and broke into violent weeping. He begged me, in the name of God and for the sake of his family, to save him from the lunatic asylum. He would sit in the midst of his family for hours and have nothing to say, and brood over his misfortune; he took no interest in his affairs whatever, and, although a politician, he could not read the daily papers. He slept poorly, but had a good appetite and took very little exercise, smoked moderately, and drank no intoxicants. He complained bitterly of pain in the brow. The reflexes were all diminished, and the knee-jerk was absent on one side, the left, and present, to a slight degree, on the right. This led me to suspect a lesion of the spinal cord, and I, accordingly, gave a guarded prognosis. To my delight, however, and to my great surprise, and contrary to my expectations, he rapidly improved, and in a few months was able to resume his work, and is, to-day, apparently well. A careful analysis of his urine showed that he was passing 1400 cubic centimetres in the twenty-four hours, of neutral reaction, with a specific gravity of 1.025, and 78 $^1/_2$ grammes of solids, and only 22 grammes of urea. No albumin, no sugar, no bile, no casts, urates normal, and great excess of earthy and alkaline phosphates. This case is similar to the case just reported, and, as they are very nearly like the great number of cases of this kind, it will be well to consider the treatment based upon the hypothesis already outlined.

If, as has already been mentioned, metabolism takes place most extensively in the muscles of the body, and muscular exercise causes an immediate increased elimination of carbon dioxide and an increased elimination of urea on the day following, it seems rational to conclude that muscular exercise should be an important factor in the treatment of these cases of neurasthenia. Besides, in muscular exercise in moderation we produce conditions favorable to brain-rest; and only in long, refreshing sleep can we expect to rest the tired brain-cells and cause them to assimilate the material from the food

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necessary to their nutrition. The question arises: What is the best method of administering the necessary exercise to these muscle-cells to make them "hop around," as it were, and make their proper chemical changes, and thereby rid the system of poison? Massage, horseback-riding, bicycle-riding, walking, etc., are all good so far as they go, but they are all followed by fatigue, and these patients are already fatigued. They get up in the morning tired, and they go to bed tired. In electricity, however, we have a means of exercising not only the muscles of the body, but also the liver, the spleen, the kidneys, the stomach, and the intestines, and do all this in such a quiet gentle way as to be rather restful to the patient, and leave him invigorated instead of fatigued.

It is my custom, in treating these cases, to begin by passing a very gentle galvanic current through the superior cervical ganglia, by placing a large pad over the solar plexus, or over the pit of the stomach, and, by a bifurcated cord, two small electrodes: one under each ear. This current, which should not be strong enough to produce uncomfortable dizziness, is allowed to pass for five minutes. Thus we gently stimulate the cells of the cortex cerebri and of the spinal cord, and through the pneumogastric we influence the stomach and intestines and increase their secretions, and, as the cells in the brain and spinal cord are toned or gently stimulated, they are better prepared to transmit to the muscles and glands, when these are exercised or stimulated, that degree of healthy energy so necessary to enable them to functionate physiologically, and to produce those chemical changes so necessary to perfect nutrition.

This treatment is followed by general galvanization, and then by general faradization as described years ago by Dr. Rockwell, of New York City, an esteemed member of this association. My method of applying general galvanization is to place a pad, at least twelve inches square, on the bed, table, or operating-chair, and allow my patient to lie on this pad, which is placed so as to cover the lumbar and lower dorsal spine; then, with an interrupting hand electrode, I go over every muscle of the body and produce gentle contractions. This acts directly upon the muscle-protoplasm, and by chemical action of the current upon the muscular tissue metabolism is aided. The same method is followed with the faradic current, and, as the contractions are produced by the action of this current upon the terminal nerve-fibres, we must call into action also the motor and sensory cells of the cortex and of the spinal cord. As

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we are told by physicists that, before we can have a current-flow from pole to pole, all conductors within a specified area must be charged by induction, it is reasonable to conclude that all conducting material of the body is charged at every make and break of the current, and that absolutely no tissue of the body escapes the energizing influence of the electric current.

The liver, the stomach, and the spleen are all treated in their turn as they are reached, and when this is finished the patient is placed in my ozone-cage and treated to the soothing spray for from ten to fifteen minutes; during this time he inhales deeply the ozone generated in the cage. In a very short time his sleep improves, his bowels become regular, and he takes normal exercise without fatigue; an analysis of the urine will show an increased elimination of urea and diminution of phosphates, and, as improvement continues, these products of catabolism approach nearer and nearer the normal to complete recovery. If, after galvanic and faradic treatment, the patient experiences a sense of fatigue, he is allowed to remain in the static cage ten to fifteen minutes, and, upon coming out, he usually experiences a feeling of exhilaration, which is followed in a short time by drowsiness and desire to sleep, and this sleep is usually very refreshing and followed by much relief from fatigue and nervousness.

The static cage I have found most beneficial in all cases requiring a soothing effect and at the same time gentle general stimulation. A number of hard-working lawyers and statesmen have taken treatment after the days of toil and struggle, and have invariably expressed themselves as materially relieved and rested, enabling them to attend more thoroughly to their business the following day.

Since I introduced this particular form of cage with the tinsel brushes to the profession, in a paper read before this association at Toronto in 1895, I have treated beneficially by its aid many functional nervous troubles, and have had a great many letters of inquiry concerning its construction and general utility. Among others, I received a letter from Dr. Monell, of Brooklyn, requesting a general description, the cost of making, the class of cases treated therein, etc. This letter I now have in my possession, and it may be seen and read by anyone desiring. You can imagine my surprise when a cut of this cage appeared recently in Dr. Monell's book as the product of his own brain.

Many cases of neurasthenia have been treated in this cage alone

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and have been cured, but the class of cases now under discussion I have found more readily cured by the treatment already outlined, but, even in these cases, the static cage is invaluable.

Finally, in support of my argument, I quote the following text from Landois and Sterling's "Physiology":—

"A motor nerve excites chemical destructive changes in a muscle, and is so far the catabolic nerve of that tissue; in the same way, the sympathetic to the heart, by causing more rapid contractions, is also a catabolic nerve; while the vagus, as it arrests the heart's action, brings about constructive metabolism of the cardiac tissue, is an anabolic nerve."

DISCUSSION.

DR. A. D. ROCKWELL said he had been deeply interested in this eminently-practical paper, particularly as it dealt with the subject of neurasthenia. He was of the opinion that there are two principal causes of neurasthenia giving rise to two distinct forms, viz.: (1) the hereditary and (2) the acquired. There was an hereditary type of neurasthenia which is very sad, in which the patient appears to be well, yet is suffering very keenly. Sometimes the hereditary tendency skips a generation or two. Dissipation or worry greatly accentuates this form of neurasthenia. To be successful in the treatment of these cases it was absolutely essential to gain the confidence of the patient. It was difficult to treat neurasthenics without at least the occasional use of drugs. He has found the bromides and cannabis Indica valuable, and he knew of no better combination than the proprietary preparation known as neurosin as a temporary expedient. The physician must also allow the patient's intellectuality to come in, instructing him to think of his condition and endeavor in this way to rise above it.

DR. W. H. WHITE asked if Dr. Rockwell had made use of the zinc preparations, and with what results.

DR. ROCKWELL replied that he had used them, and had found them of considerable value.

DR. BROWER, of Chicago, congratulated the author on the practical character of this contribution, minute directions being given for the benefit of those who desire to give the method a trial. He desired to emphasize a remark made here yesterday by Dr. Massey: *i.e.*, the close and intimate relation of the abdominal cavity to neurasthenia. Much of the autointoxication spoken of has its origin in the abdominal cavity. In many of his neurasthenics he found dilatation of the stomach, interfering, of course, most seriously with the very foundation of the digestive process. This condition was so common that he made it a rule to search for it. Another very common condition in these patients was failure of elimination through the intestinal tract: an impaction in the colon. Until this had been relieved by flushing, and its recurrence prevented by proper electrical treatment, a certain number of unnecessary failures would occur.

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DR. ROCKWELL said that in the cases spoken of by the last speaker lithæmia was the underlying cause. He was accustomed to distinguish between lithæmic neurasthenia and true neurasthenia just as he distinguished between lithæmic neuralgia and true neuralgia.

DR. S. F. WILSON added his congratulations to those already offered to the author of the paper. Mention was made of the case of an old lady who had been seized with a peculiar dread of everything after a severe attack of pneumonia. Examination of the urine had shown nothing except a deficiency of that excretion. She had been treated electrically and hydropathically, and with success. Static electricity was used,—head breeze with small sparks over the abdomen,—and particular attention given to the state of the bowel and kidneys. Another woman had come to him complaining of sleeplessness and a tendency to burst into tears without adequate provocation. Here also the urine had been deficient, but under the same treatment the insomnia had been completely relieved within a week or ten days. Constipation seemed an omnipresent factor in these cases of neurasthenia. The cases were presented in confirmation of the statements already made.

DR. MARGARET A. CLEAVES expressed her pleasure in hearing the paper read. She said that every now and then a neurasthenic seemed to require something more than the convective discharge. For such patients she was in the habit of using the galvanic current in the form of the vaginal hydropathic douche. Dr. Bishop's apparatus acts like covering the patient with the large crown electrode, so that the discharge is through the whole body instead of simply from the head. Of course, a large amount of ozone is generated, but the name "ozone-cage" was perhaps a little misleading as directing the attention away from the main point.

DR BISHOP, in closing, thanked the association for its kind reception of his paper. He had not attempted to discuss the subject of neurasthenia in full; medicines were, of course, occasionally required, but the object of the paper was to concentrate attention on the electrical treatment.

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CEREBRAL NEURASTHENIA, OR FAILURE OF BRAIN-POWER, WITH SPECIAL REFERENCE TO ITS ELECTRO-THERAPEUTICS.

By Daniel R. Brower, M.D., LL.D., Chicago, Ill.

Cerebral neurasthenia, or brain-failure, is very common to-day. It is ordinarily manifested by fatigue of the mind and body after trifling exertion, by failure of memory, by depression of spirits for apparently insufficient cause, by unreasonable introspection and retrospection, by morbid fears, by inability to solve the ordinary problems of the day with usual facility, and by general discomfort through the body without any evidence of organic brain disease. Indeed, the suddenness with which improvement and even recovery may take place is evidence against an organic basis and in favor of its purely functional character. It is a nutritive disturbance of the neurons, and the character of the changes that take place in this nerve-element by fatigue and toxins has been demonstrated for us by Hodge, Barker, Donaldson, and numerous other investigators, and through these valuable researches a flood of light has been thrown upon the pathogenesis of this disease.

The principal factors that are at work making failure of brain-power so commonplace are the intense activity of the age; the earnest competition that is manifest everywhere, resulting in the failure and disappointment of the many; the unrest that prevails on all sides, causing numerous people to cut loose from the moorings of the past, and drift faithlessly in the sea of doubt, with no respect for authority, no religious faith; while "young America" and the "new woman" are causative factors not to be overlooked. Because of this state of society so-called Christian Science, faith-healing, and such like absurdities abound, possibly adding to the distraction.

It is not my intention to discuss the drug nor the general hygienic treatment of brain-failure, although they are most essential, but I intend to limit myself to those electro-therapeutic methods that I have found valuable aids. The physical basis of every case is a loss of the balance between waste and repair, resulting in the expenditure of nerve-force in excess of supply, with ultimate exhaustion of the stock of reserve energy so essential to our well-being. The primary source of repair is the gastro-intestinal tract, and in my experience it is rare to find a case without disorder here. A dilated stomach or an impacted colon, or both, constitute the founda-

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tion on which the errors of nutrition rest, giving rise to autointoxication and general anæmia. The dilated stomach must be successfully treated in order to relieve the neurasthenia, and while lavage, strychnia, and a properly-regulated diet are essential, yet no single remedy can be compared with the intragastric application of faradism. The technique is simple. The patient can soon learn it, and use it as readily as he does the stomach-tube. He should drink at least a half-pint of warm water, then swallow the Einhorn electrode, using a current strong enough to produce decided contractions. The *séance* should be daily, and about five minutes in duration. The application of the interrupted current through the abdominal wall is much less efficient, and yet in some cases it will have to be substituted. A large electrode should be employed with the secondary current. A better percutaneous treatment can be given by using the roller electrode with the static induced current. These electrical applications should be made three or four hours after a meal. The impacted colon, of course, requires aloetic laxatives and colonic flushing with warm, normal, saline solution; but this should be followed by intestinal faradization, using a rectal electrode as one pole and applying the other over the entire abdominal surface, in order to restore the muscular tonus of the intestine.

Cerebral neurasthenia requires cerebral galvanization. Some of the distinguished members of the profession do not accept the proposition that the brain is affected by galvanism, and insist that when results are obtained they are psychical, or purely suggestive. One of the surprising things of the times is the failure on the part of so many to appreciate the remedial power of this agent, the striking effects of which are so visible on every side as to entitle this to be called the electrical age. That the brain is affected by galvanism was demonstrated by the researches of Erb, Burckhardt, and Bückner, and long ago accepted by such leaders of medical thought as von Ziemssen, Benedict, Hayem, Althaus, and a host of others too numerous to mention. It may be demonstrated at any time by the vertigo, the forced movements, the cerebral malaise; the disturbance of consciousness, of sight, of taste, and of hearing; the vomiting, the pallor of the face, somnolence, and syncope which may follow cerebral galvanization.

The electrodes I use are about three by seven inches. One is placed on the forehead, and the other at the nucha. The general characteristics of the mental phenomena determine the polarity: if

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one of depression, the negative is placed at the forehead; if excitement, then the positive. The currents used are of low ampèrage, never exceeding 2 milliampères, and rarely using more than one. The application should be continued for five minutes. This longitudinal galvanization is followed by transverse galvanization, using the same electrode, with a current-strength from $^1/_2$ to 1 milliampère, and a five-minute *séance*. The transverse galvanization is to be followed by bulbar galvanization. The positive electrode of the size above mentioned is placed at the nucha, and a round electrode about one and a half inches in diameter (the negative) is moved up and down over the ganglia of the cervical sympathetic on both sides without breaking the current. This *séance* should be continued for five minutes. The treatment by galvanism is followed by a static insulation and sparks from the spine. The static machine used should be one that will furnish a spark of at least ten inches. The electrical treatment should be given daily for the first ten days, then every other day will be sufficient.

DISCUSSION.

DR. MASSEY said that the ideas in this paper are strikingly similar to those expressed by himself a day or two ago in connection with the subject of neurasthenia. The speaker said that many neurologists did not lay sufficient stress on the part played by the abdomen in this disease. It was interesting to know that the patient could himself administer the faradic current to the stomach. The relative value of intragastric and percutaneous applications had been pretty thoroughly discussed at the last meeting. It had been stated at that time that one should make sure that gastric dilatation was actually present before deciding upon the necessity for intragastric treatment. He understood the reader to say that the secondary current was used. If he had a good primary it would be found oftentimes more effective in the external treatment. From long experience he had learned to prefer the primary to the secondary for these abdominal applications, on account of greater contractility.

DR. W. S. WATSON, of Fishkill, N. Y., commended the paper very highly for its practical character. He thoroughly agreed with the author as to the use of galvanization in these cases of "brain-tire."

DR. BROWER, in closing, emphasized the close relation, not only of cerebral neurasthenia, but of all kinds of neurasthenia to disorders in the abdominal cavity, for he was sure it was very commonly overlooked. It was not an uncommon experience in his consultation practice to be called upon to demonstrate to the family physician the existence of an impacted colon and a dilated stomach. No good result could be expected from electricity or other measures unless these conditions receive due attention. He pointed out the great advantage of using currents of low ampèrage and protracted applications in cerebral galvanization of neurasthenics.

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THE ELECTROSTATIC TREATMENT OF NEURASTHENIA.

By William Benham Snow, M.D., New York.

Neurasthenia, also known as the American disease, from the fact that it is so much more common with us than among the slow, easy-going nations of the old world, is a functional disorder usually caused by errors of life and habit.

The indulgence in luxuries by those who, as a matter of fact, take but little exercise, with excesses both of eating and drinking, sexual excess, self-abuse, and erotic states induced by undue excitement of passion, long engagements, tight-lacing, social engagements, late hours, together with the hustle and bustle of modern competition in business are causes creating a variety of derangements finally ending in nervous exhaustion with all degrees of hyperæsthesia, anæsthesia, insomnia, and perversions innumerable. Various as are the causes and conditions arising from unnatural habits of life, one word is coined to include them all, *neurasthenia*, and one rule—a return to a natural life—is the prerequisite if health is to be restored.

Many sufferers from this condition in this generation have received it, or a strong predisposition, as a heritage. Such furnish the most stubborn and intractable cases, and may never be cured, but may or may not gradually lapse into grave nervous conditions. While the aggregate of this class is large, they make up but a small percentage of the neurasthenics we meet. The prognosis is hopeful if some organic disease has not already attacked the patient. If only functional derangements are to be combated the chances of recovery are good.

As varied as are the causes, so are the symptoms of neurasthenia. Anæmia, insomnia, constipation, indigestion, sluggish conditions of the organs of secretion and excretion, and irregular pains —especially in the back, neck, and head—are symptoms all present in a large percentage of the cases. Hysteria is present in very many, and must be mastered early. Areas of anæsthesia or hyperæsthesia and irregular neuralgic pains are frequent symptoms. Some lapse into melancholia. There may be grave apprehension of impending death from suspected disease of the heart, or other imagined disorder. Temporary impotence, suspension of menses, and disorders of the pelvic organs may play a large part in the causation and be

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obstacles to the prompt recovery of the patient. A most complete and careful analysis of every case is imperative before any treatment is instituted; then start right.

Find the cause or causes and remove them. Place the patient under favorable surroundings, and do not prescribe rest, but healthful, well-regulated out-of-door exercise and diversion in most every case. To this add careful judicious feeding, insure one daily evacuation commensurate to food ingested, and encourage drinking of pure water. Discourage the use of stimulants and excitement or recreation that will cause fatigue. Very cautiously prescribe hypnotics and nerve-sedatives, but allow iron or strychnine if indicated. Such a *résumé* would cure many cases in a season, but in others the sway of the pendulum has become so slow, and nervous and physical resources have been reduced to such a low ebb, that some active energizing force is necessary to gently, but firmly, turn back the tide. Will rest and massage best serve the purpose? No, both are passive; they lack initiative. Impulse must be started from centres even though first aroused from the periphery. The normal relation of nerve and muscle is one designed for concerted action, and they rise and fall together. Passive motion or rest neither afford an incentive to restoration nor do they induce nutrition. On the other hand, an agency under control, gently and judiciously administered, which promotes the functional activity—not of one muscle, but of all muscles; not of one nerve, but of all nerves; not of one organ, but of all—requires in addition only nutritive pabulum to promote restoration. The first law of life and health is exercise: not passive, but active.

The body recuperates during rest; most vigorously when rest follows exercise. The muscle that develops most is the one that has the most judicious exercise. Under forced rest a muscle atrophies. Nature, then, demands properly-regulated exercise, not rest, for recuperation and development. The means required to facilitate Nature's efforts to restore the neurasthenic are: first, correction of habit; second, congenial surroundings; third, judicious, well-regulated exercise; and, fourth, an agency which, by unlocking secretions, quieting nervous irritability, and overcoming local disturbances, will best assist the normal resumption of every bodily function.

The varied applications of static electricity satisfactorily meet these requirements. For the general tonic effects indicated in every

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case of neurasthenia the wave-current should be administered, by placing the long spinal electrode (one inch in width and eighteen to twenty-two inches in length), over the vertebral column from the cervical to the lumbar region for from at least fifteen to twenty minutes, and employing as long a spark-gap as may be used without causing uncomfortable muscular contractions.

Patients will usually take a treatment with four-inch spark discharging. Though persons with small muscles and but little fat may not bear a two-inch spark-gap current, large or fat persons will bear and require one measured by a five- or six- inch spark discharge. After the first few applications the patient perspires gently with each such treatment. Not only does the activity of sweat-glands resume, but there is a gradually-increasing resumption of other functions. There is marked increase in the daily excretion of solids in the urine, digestion improves, appetite returns, and the bowels become more regular. In short, there is a general improvement of every metabolic function.

While many cases have been cured by no other agency than the wave-current, we believe that the active peripheral stimulation and massage afforded by the long and friction sparks hasten the recovery of every case, the time-factor of which will depend on the duration of the affection, the adherence to regimen, the extent of functional derangement, the recuperative powers of the patient, the regularity with which the treatments are administered, and the technique employed. Treatment should be given daily for at least two weeks, when every second day may suffice.

Special symptoms will require special attention, as follows:—

A dilated or atonic condition of the stomach will require sparks applied directly over the organ. And the same treatment will awaken the activity of a torpid liver and assist in overcoming the constipation usually present.

All sensory disturbances may be relieved by long or short sparks, friction sparks, or local application of the wave-current. Headache will be relieved by placing the stand electrode with point over head if patient is anæmic, or at the level of the knees if asthenic during the administration of static wave-current.

Palpitation of the heart and conditions of general malnutrition will usually call for no additional treatment.

In all cases, especially those of long standing, insomnia is often a most stubborn symptom, but uniformly yields where no brain-

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lesion is present. A treatment administered just before retiring is most apt to induce refreshing sleep.

The wave-current applied directly over the eyes or temple will relieve disagreeable eye-symptoms, and over the larynx an aphonia of nervous origin.

The sexual functions require no special treatment, but restored confidence and the general treatment.

Ovarian, uterine, or the pelvic congestions should receive proper local treatment with the wave-current. Hysteria and other symptoms of neurasthenia may be promptly cured by the general and local treatment, as indicated.

The occupation neuroses occur, as a rule, in neurasthenics, and must have the general, as well as the local, treatment. When treated early, these cases uniformly yield to the proper technique.

There is no nervous disorder more common to-day and no curable affection which has so often taxed professional skill as neurasthenia; and we are sure that there is no known therapeutic means which so well meets the demands as static electricity. The results of administration are charming to those who have followed other plans of treatment. The improvement is marked after the first few treatments, and the result generally satisfactory.

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ELECTRO-THERAPEUTICS IN INSANITY.

By Alfred Tennyson Livingston, M.D., Jamestown, N. Y.

It is a little more than nineteen years since I first made use of electricity in treating the brain disorder in a case of insanity; in other words, the central and all-important condition. During six or seven years previous to that I had used electricity in some of the associated conditions: notably, to set up the function of menstruation, which is so often suspended in the acute stage of insanity.

Reasoning analogically upon the results of my experience with electricity in other conditions, I could only conclude that it ought to be of great benefit in treating the direct cause of the mental alienation. I was about to make my first experiment in this direction when I was visited by my friend and master in lunacy, the late Dr. John P. Gray, of Utica, N. Y. I embraced the opportunity to discuss the subject with him, hoping to have the moral support of his approval. I had shown him my patients, and after unfolding my theory I asked his opinion as to its application to one of them, a woman about 30, wife of a clergyman, a case of acute melancholia. He promptly replied: "Don't do it! Don't do it! It will only intensify her excitement." I argued that I was not thinking of applying the current to the brain, but to those centres which control the brain-circulation. I did not modify his first impression and our discussion ended with his earnest charge to "never use electricity in any acute case of insanity."

Finding next morning that the more stoutly my theory had been opposed, the more firmly I believed in it, I took my battery to the patient's room and applied the current as nearly as I could through the lower, middle, and upper cervical sympathetics. Before the treatment was half completed I recognized a distinct calmative effect. Three weeks later I discharged the patient, recovered.

About five years after this, having removed to Jamestown, N. Y., I was requested by my friend, the late Dr. J. B. Andrews, with whom I had been associated on the Utica staff, but who at that time was superintendent of the Buffalo State Hospital, to take charge of a case of acute mania, a young woman about 20, who resided near Geneseo, N. Y. At the doctor's request, I went to Geneseo by way of Buffalo, and he met me at the station to talk the case over. I had my battery along with me, and I noticed the doctor's curious glances toward it.

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Finally he asked: "What have you got there?"

"A galvanic battery," I replied.

"What are you going to do with that?"

"Oh!" I said, "I thought I might have use for it."

He asked no more questions about it, but his expression suggested that he might be wondering whether I was not needing the same sort of treatment as the young lady at Geneseo.

I found her a vigorous, violent girl, who was evidently accustomed to have her own way, and she had been running the whole establishment before I went there. She was so strong that it required three unusually large and powerful nurses to hold her upon the bed when I began to give her the electricity. Before completing the first treatment she was asleep, and this result occurred with each treatment. At the end of a month she had recovered, and has continued well since.

Last summer I visited several of the more noted asylums of Scotland and England. I inquired carefully, in each instance, as to the use of electricity in the treatment of the insane, with the result that one superintendent said that seven or eight years before one of his assistants had experimented with seven patients and had written a report of his work, but that the results of those experiments had not led them to make further use of it. In none of the other institutions had there been any experience with it, nor did the medical officers know of its use elsewhere.

I mention these incidents to illustrate the lack of experience in the use of electricity among medical officers of institutions for the insane. I can appreciate this neglect of a novel therapeutic agent when I reflect that during the years that I was assistant physician at Utica I accepted the belief that prevailed there that we did all that could be done to cure our cases, and, although I then used electricity for some specific conditions in my patients, it did not occur to me to use it as a direct means of curing the insanity. There is probably no other class of hospitals in which there is such a tendency to drop into routine methods and accept them as the *desiderata*.

My later experience demonstrated to me that we had done but a moiety of what we might have accomplished either as to promptness of cure or percentage of cures. I have learned that to do the *utmost* for any patient who is seriously ill demands much of the physician's time as well as thought, and this is especially true in

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our department of work. This suggests an important point in my subject: the practical application of electro-therapeutics to the insane in the large public institutions in which a large majority of such patients are treated.

It is not possible for any physician to properly and sufficiently apply electro-therapeutics or any other therapeusis, to three hundred or more patients, which number was daily under my care while at Utica. When legislators cease to be controlled by political considerations and become broad, philosophical statesmen, they will recognize the economy of making asylums for the insane hospitals for cure rather than places for custody, and we will then see a ratio of physicians to patients, that will allow of such work being done and such results accomplished as I have now in mind. From twenty-five to fifty patients, as they average in the public asylums, are as many as any physician can treat daily and approximate justice to each one. It is not an answer to this assertion to say that insanity is in its nature a chronic disease, and that long periods of time are as necessary in the treatment of a case as medication or discipline. The Geneseo case was prognosed by my friend, who had had charge of her for some time, as likely to continue from six to eighteen months; whereas, by methods of treatment which he was not accustomed to use, she recovered within a month. Chronic insanity usually becomes so because, as acute insanity, it was not properly or sufficiently treated; and incurable insanity becomes so because as chronic insanity little or nothing was done to prevent the fixation of pathological organic states. On glancing over what I have just said I see that I might be charged with inappreciation of the State's provision for her insane wards. I desire to distinctly disclaim this, because I recognize the almost lavish liberality of her response, with means to erect and equip asylums for this class. It is possible that the deficiency to which I referred is more due to the lack of appreciation, by the medical heads of those institutions, of the vastly greater results that might be accomplished by a much larger medical staff.

The theory upon which I began to apply electricity to the central pathological state in insanity was that the abnormal cell-function and consequent excitement and defective control, which are the essential elements of acute insanity, are due to abnormal relations of the blood-supply to the brain, chiefly quantitative and usually (practically uniformly in the acute stage) excessive; that this congestion of cerebral vessels is directly due to a deficient force-

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supply from the vasomotor centres presiding over them; therefore that the stimulation of those motor centres ought to arouse them to the production of more force which, being supplied to the congested vessels, would contract them and so immediately relieve the exhausted and irritable brain-cells, producing calm, which state, together with the better activity of the brain-circulation, would promote those nutritive changes which produce normal states of tissue.

However crude this theory may seem to those who pay more attention to ultimate pathology, I have seen no reason since then to essentially change my theory of twenty years ago. Ten years ago I discovered a fact which, I think, has bearing upon the influence of galvanism as I have observed it in treating insanity and other disorders, viz.: that the body becomes a storage battery when the constant current is poured into it. Previous to that discovery I had supposed that the prolongation of effect beyond the discontinuance of a treatment was wholly due to the increased activity set up in the organ treated, to which belief I have since added that of the after-use of force stored during the treatment. However, I lay much stress upon the method of application, and I believe it to be a general rule that the current should pass through the nervous centre which is related to the part of the body to be affected. I therefore apply the electrodes over the three pairs of cervical sympathetic ganglia, beginning and ending with the lower pair. I select rather small hand electrodes to more definitely limit the current-stream to the parts designated. I measure from 10 to 15 milliampères through the lower pair, from 8 to 10 through the middle pair, and from 5 to 8 through the upper pair. I slide the electrodes with firm pressure from one position to another to avoid shock, and I reduce the current as I ascend, because the larger current would there produce unpleasant subjective sensations, both superficial and central. When making the final application to the lower pair I sometimes break the current repeatedly by removing one or both electrodes and replacing, as it has seemed to me to increase the ganglionic activity. I have carefully avoided the application of the current directly to the head in acute cases, but I would certainly use it in this manner in some of the chronic states, especially in dementia. In those acute cases in which there is great nervousness and restlessness I move the electrodes down the back as far as the sacrum, keeping them about four inches apart, and equidistant from the vertebral spines.

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I have had the most delightful results from this procedure in the habit cases, with which every alienist has to deal, and I do not know of any other means which will so efficiently relieve the awful agitation that follows, after twenty-four or thirty-six hours, the cutting off of the stimulant used, whether alcoholics, opiate, or other narcotic. While I do not recognize these cases as belonging to the mental insanities, I think this particular stage might be called a motor delirium from narcotic poisoning, and I am quite sure that anyone who has dealt with it, as I have done many times, will not be likely to forget the experience.

I have never used galvanism in frenzy of mania or melancholia, but were I called upon to treat such a case it would be the first means I would try, and I would persist in it, notwithstanding the very great difficulty there would be experienced in keeping the electrodes in place long enough to secure a positive effect.

As I intimated at the beginning, there are many disorders associated with insanity in which the use of electricity is indicated. Those of the digestive system are probably the most common, and more frequent than any other one condition is constipation. Galvanism is a grand stimulant to glandular secretion, the correcting of which is the chief *desideratum* in treating defective digestion, and faradism, as we all know, is an efficient stimulus to peristalsis.

Among insane women the pelvic disorders should receive the thorough attention of the electro-therapeutist. While I was associated with the Utica State Hospital the pelvic affections of women were practically ignored, so much so that even a vaginal examination was a great rarity, at which the assistant physician had to be chaperoned by the superintendent. The theory acted upon was that, when the general condition of the patient had improved to a certain degree, the local disorders would be righted, and that it was undesirable to interfere with the sexual apparatus. I so far disregarded this unwritten law that I instituted, while there, the setting up of the function of menstruation in suspended cases; but those so treated were chiefly convalescents. When I later had the entire responsibility for my patients I applied the principle that the more disordered functions of the body that I could correct and the more promptly that I could correct them, the better chance the patient would have to recover from the insanity. I therefore began promptly in acute cases to set up the menstrual function if it did not appear at the proper time, and I always succeeded, though not always with the first series of applications.

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One case was so striking as to deserve relating. A young woman who had been an invalid for some time, was operated upon by her physician; as I now recall, it was curetting of the womb. As she came out of the anæsthesia she came into a state of acute mania, and within seventy-two hours was a patient in my home. A few days later she should have menstruated, but instead of that function there developed the most terrible mania that I have ever seen. I at once used galvanism to bring on menstruation, but the fearful cyclone of brain-activity thwarted my efforts. This incident occurred a short time before my first experiment with galvanism in allaying cerebral excitement; so that I did not employ what I now believe would have been the best means to that end, but did use in repeated hypodermics, during the evening following the development of this cyclone, $1\,^1/_2$ grains of hyoscyamine, with not a particle of apparent effect. The next night I gave her 8 ounces of ether with no better result, and then (notwithstanding that I had been prohibited by the mother from using it) I gave her chloroform until she was soundly asleep, with pulse as soft as a baby's. The sleep continued six hours. I was obliged to use the chloroform eight successive nights, each administration occupying about an hour. I anticipated the next menstrual period by three or four days, applying galvanism through the ovaries each day, and had the satisfaction of setting up the function at the proper time, and thus avoided a repetition of the terrible experience of a month before.

It would be superfluous to enlarge upon the various pelvic disorders associated with the insane, since they are the same conditions which are found associated with other forms of nervous disorders, but I may say that in acute states of insanity in women there will almost invariably be found some form of pelvic disease—uterine, ovarian, tubular, cystic, or rectal—which was most probably causative; but, if not causative of the mental breakdown, is certainly, from reflex irritation, a serious obstacle to the restoration of the normal brain function and should be treated as the same condition would be treated in the sane, regardless of the patient's delusions or the prejudices of the patient's friends. In these conditions, therefore, electro-therapeutics has the same application as in like states in the sane.

This is one of the points which I would emphasize: that, in any given case of insanity, whatever function of the body is wrong should be righted as promptly as possible as a means toward the general

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object of restoring mental equilibrium. The other point which I would impress is that electro-therapeutics should have a very prominent place in treating the central affection, and that such treatment should be employed immediately instead of waiting passively for general physical improvement to bring about a better state of the brain. If you compare two persons equally sick and alike sick, one of whom is sane and the other insane, you will find but one point in which they differ, viz.: as to self-control. The one who controls himself is calm; the one who is not calm may be made so, as I have many times demonstrated, by the proper use of electricity.

We, who are privileged to watch the waning of the Wonderful Century, behold many strange and beautiful and beneficent effects of this occult force, among which its therapeutic triumphs have the highest place; but my own heart has been the most deeply stirred to gratitude when I have seen it "minister to the mind diseased and raze out the written troubles of the brain."

Jamestown, N. Y., September 21, 1900.

DISCUSSION.

DR. MASSEY expressed his very keen appreciation of this admirable paper. About twenty years ago he had been an assistant physician in one of the largest insane-asylums in Pennsylvania. He had served there for three years, and could also testify to the systematic neglect of pelvic and other disorders. The States still make the mistake of building large institutions filled with chronics and incurables, with the acute and curable cases scattered among them. Such an arrangement cannot possibly give the medical attendants an opportunity for proper treatment of their charges. Static electricity seemed to him to offer much hope of relief in this class of cases. He had begun his experience with the static machine as an agnostic, but he was now a firm believer in the benefit of a long-continued application from a machine run, not by a boy, but by a motor. In the Friends' Asylum in Philadelphia an effort had been made to do something with static electricity, but so far little had been accomplished. It is possible that we must look to the private asylums for advances in this direction.

DR. W. T. BISHOP remarked that the question of dollars and cents has much to do with this state of affairs. One step in advance had been to change the name from asylum to hospital. In his opinion the cottage idea would bring out the direct responsibility of the medical attendant. To secure the needed changes one must secure the co-operation and financial support of the public.

DR. E. B. SILVERS, of Rahway, N. J., said that a speedy cure of the insane was a most important, but exceedingly-difficult, problem. In one county in New Jersey there was a hospital for acute cases of insanity, and they were not sent to the asylum proper until it was thought these cases were beyond the reach of medical treatment. In alcoholic patients the use of cannabis Indica

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internally and electricity externally had succeeded very well in his hands, and the method had been tried by Dr. Ward, of the Trenton Hospital for the Insane, with good results. He heartily indorsed the statement that reflex action should always be recognized.

DR. R. REYBURN, of Washington, D. C., said that a very large hospital in Washington receives all the insane from the army and navy and from the District of Columbia, but it is entirely too large, and is built on a wrong plan. The great expense of these institutions is largely owed to the palatial buildings provided for them. The patients were given sedatives, and that is about all in the way of treatment. The remedy for this state of affairs must come from the medical profession. It would be better to put the same money on the grounds rather than on the buildings.

DR. W. E. FORD, of Utica, N. Y., said that the large number of insane persons that gather into a lunatic asylum float around among the profession for a period of from one year to a year and a half without receiving any benefit, before they reach the asylum. The ranks of the insane are recruited from neurasthenics who go from one physician to another from month to month and from year to year. The reason they are not oftener cured is because of the want of appreciation of the gravity of these cases, and the putting off of these unfortunates with some cheap excuse rather than be bothered with them. It was for this reason that they so often reach the hands of the Christian Scientists, and personally he would rather be in the hands of that sect than under the care of many of the neurologists with whom he was acquainted. Many of these Christian Scientists were formerly patients who had bored him to death, and they had now been cured. This was because he had not had the necessary knowledge, or had not given the necessary attention to these nervous invalids. A neurasthenic was not going to come to your office to be "talked up" three times a week, and moreover this process is quite exhausting to the physician. Whether electricity will control the vasomotor system or acts as a stimulant to the nervous system, which he believed it did, or whether it went through the skull, which he believed it never did, he was positive that electricity always did these people some good. It accomplished this by giving them something to do, and keeping them out of the hands of quacks, if nothing more. There was certainly a large number of so-called neurasthenics who were really melancholiacs, and he believed that, generally speaking, neurasthenia was a mild form of melancholia. The mild stage of dementia which follows serious neurasthenia is the same mild condition of dementia which follows acute and mild melancholia. The relaxed condition of the capillaries seen in these patients could be immensely improved by electrical treatment—much more so than by drug treatment. Our effort should be to give to general practitioners such notions of the use of electricity that they can do these people good before the time when they reach the lunatic asylum.

DR. BROWER said that the class of cases spoken of in this paper was the product of the improper treatment of the class of cases described in his own paper. He had long felt that the medical profession was too prone to rush these cases off too soon to the insane-asylum. Among the poor there were many insane people who could be more successfully treated in a general hospital than

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in the insane hospital. He always had under his care in the Chicago Hospital half a dozen or more cases of this kind. Almost every town of importance has a general hospital, and in it many of these cases could be properly treated. This was certainly far better than committing them prematurely to the insane hospital.

DR. WILLIAM J. MORTON said that the opinions expressed by Dr. Ford were thoroughly in accord with his own. His own practice was largely among neurasthenics and incipient cases of melancholia. He had done his share long ago toward publishing methods of treating these cases. He did not believe at all in the "rest-cure," but they were amenable to other means. Only this summer he had been summoned to the city to see a young man who had relapsed into melancholia. He had been a neurasthenic for four years, and had been under his treatment for a few months, and he had predicted this termination of the case. He did not attach much importance to the diseases of women as having influence on neurasthenia. The association would do well to spread the views that had been expressed in this discussion. He had had little personal experience with the treatment of these cases with the galvanic current, and for this reason he had more confidence in some forms of the current from the static machine, particularly in the powerful convective discharge or spray from a powerful machine. The wave-current produces a sense of fatigue very rapidly, and this seemed to him an advantage, for it simulated the application of splints in other conditions. This was not really a true physical fatigue, but rather one of temporary languor leading to refreshing sleep. He was of the opinion that all of these neurasthenics should be taken care of by the general practitioner, and he had very little respect for the treatment ordinarily meted out to these poor neurasthenics. He was inclined to believe that about 50 per cent. of his successes among these neurasthenics were the result of stopping them from doing what various general practitioners had advised them to do. They were usually dosed and dosed with "tonics" and all possible changes rung on these preparations. A favorite drug was strychnine; yet, in his opinion, this was a most unfortunate selection, for, if continued for some time, the patient becomes exceedingly irritable and excitable. It was usually after the general practitioner had done this much harm that he became alarmed and sent the patient to the neurologist. The same criticism applied to iron and to hypophosphites, and, indeed, to almost all of the usual tonics except arsenic. If such medication were stopped, bromides were prescribed, and the patient was told to take plenty of rest, abstain from starchy foods, and live chiefly on meats and salads, the result would almost always be satisfactory.

DR. W. H. WHITE referred to a woman seen recently, who had been treated previously by a homœopathic practitioner with strychnine. She had been growing steadily worse, and had three bad fainting-spells.

DR. F. B. BISHOP said that he had been interested in this subject for a good many years, one of his first papers having been on the relation of neurasthenia to insanity. In another paper he had called attention to the relation of neurasthenia to suicide. It had been his experience that neurasthenics are very prone to commit suicide, suddenly developing delusions, which are immediately responsible for these acts. He had used electrical treatment in these

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cases for many years, and it had been, for the most part, successful. He was accustomed to apply the galvanic current to the sympathetics, as outlined in the paper, and in addition he had used the static spray, surrounding the patient with what he had described as "the ozone-cage." This treatment was usually very soothing.

DR. LIVINGSTON, in closing, regretted that the discussion had not been more closely restricted to the relation of electro-therapeutics to insanity, and not to those conditions which precede insanity, although he agreed with the remarks that had been made on that subject. His own remarks had perhaps been too closely related to the asylums for the insane. He had not meant to say that electrical treatment should be confined to these institutions. He would rather, if insane, be treated by a home physician who appreciated his mental state, and had a proper knowledge of the appropriate therapeutics than be sent to an institution where he could not possibly receive the same thorough and individual treatment. The object of his paper was to call attention to the practical side of electro-therapeutics in the treatment of insanity.

DR. GEORGE E. BILL, of Harrisburg, asked Dr. Livingston to say something about the amount of current employed in these cases.

DR. LIVINGSTON said that he had mentioned the current-strength in connection with galvanization of the cervical sympathetics. He had not attempted to go into detail regarding the application to individual cases. He had stated in the paper that he regarded it as very important to treat *all* disordered states of the body, and for these other conditions he would employ electricity as ordinarily used by electro-therapeutists in general. There was a prevailing belief that an insane person did not recover from insanity until the general health was approximately normal; personally he did not think it was at all necessary to wait until the whole body is well before securing approximately the normal blood-supply to the brain: normal as to quantity. He had repeatedly secured recoveries from insanity long before he had restored the general bodily condition to health. A person who is insane is one whose mental functions are disturbed because of that sickness to the extent that he does not control himself. Two persons may be equally sick, and alike sick, yet one will exhibit no mental aberration, while the other will do so. The insanity of the one lies in his lack of self-control. He regarded insanity as dependent upon the relation of disease to disturbance of function, not to changed moral conditions. No act, no impulse, no thought of any insane person is a direct implication of insanity. He did not believe that any insane person was ever impelled to do anything that some sane person had not done. The insanity consists in altering one's individual state of mind. He firmly believed that by restoring the normal blood-supply to the head the symptoms constituting insanity would be relieved.

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GLEANINGS IN THE FIELD OF ELECTRO-THERAPEUTICS.

By Charles O. Files, M.D., Portland, Me.

Some twenty years ago, while making a double amputation, of one leg in the upper third and the other in the lower third, my assistant, who was administering ether, and who happened to be an old army-surgeon, startled me by declaring that the patient was dead. The shock of the injury, the patient having had both legs run over by the cars, combined with the shock of the operation, which was made about an hour after the injury, seemed to be more than he could rally from. Respiration had apparently ceased, the pulse in the wrist had stopped, and my hope of making a successful double amputation of the legs after a railroad injury was almost gone. There happened to be a sixteen-cell galvanic battery in my office which I knew to be in good working condition. It was quickly brought to the operating-room, and one electrode—I do not know which one—was applied to the epigastrium, the other to the base of the brain, and the man, supposed to be dead, came to life with a mighty shout which was peculiarly agreeable to my ears, at least. After the operation it was necessary to remove the patient to his home, some two or three miles away. Whenever the pulse flagged the electric current was applied by an assistant, or by myself, and life was kept in him in this manner for three weeks. This patient is alive to-day and is earning a good living.

The history of this case suggests the possibility, if not the probability, that many lives may be saved by the use of electricity that would otherwise be lost from the shock of severe surgical operations. Fischer states that in shock there is probably paralysis of the whole vasomotor system. What treatment would be so certain to overcome that paralysis as a powerful electric current? There would be hope of a successful issue, even if the patient had been apparently dead, as long as a drowning person may be submerged completely and yet restored to life. If there is hope in cases of shock where death has apparently taken place in a few seconds, there is far greater use for electricity with almost certainty of success, in cases of "severe and extensive injuries, when the patient is sinking gradually without any attempt at recovery" (Ashhurst, volume i,

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p. 369). The patient in the case here reported would probably have died any day during at least the first fortnight after the operation if electricity had not been applied when the heart showed signs of failure. This was my first really satisfactory experience with electricity as a therapeutic agent. Such a result, after an adverse prognosis from every surgeon who saw the patient at the time of the operation and for the subsequent two weeks, made a deep and lasting impression on my mind, most favorable to the use of electricity.

Another case, several years later, was almost equally startling. A young lady, twenty-five years old, with distinctly strumous and tuberculous tendencies, several members of her family having died of tuberculosis, had suffered from repeated severe attacks of bronchitis. One winter she passed in Georgia, and on her return-trip, in April, she was attacked again with the same trouble, and was obliged to stay some weeks in Boston before she could get to her home in Portland. I regret that I am unable to give an exact statement of her condition at my first visit. There was very little fever, yet she was unable to sit up more than an hour at a time; any slight exertion exhausted her so that she was obliged to lie down for hours. Her respiration was quick, and expiration was longer than inspiration. It occurred to me that electrical massage of the chest would be of service. The current from a small faradic battery was applied daily through my hand to the chest, for fifteen or twenty minutes. After a few days the same application was made to the body and limbs. This treatment was kept up daily for about two months, and occasionally for nearly two years. In less than a month she was able to sit up all day and take long walks and carriage-drives in the open air. She gained slowly in flesh, but rapidly in muscular development. Every unpleasant symptom was relieved. There remained an exaggerated susceptibility to colds, but there has been no serious illness of any kind in the years that have elapsed since the electrical treatment was begun. She has been about her business, in charge of one of the departments in a daily newspaper office, for the past five years, with no more than the ordinary amount of absence on account of indisposition. She seems to be in pretty nearly perfect health now. No specific medicinal treatment was given with the exception of a little codliver-oil and creasote in the early part of my attendance. The quantity of these medicines was by no means sufficient to account for her rapid recovery. It seems to me that much may be done by the use of electricity, and especially of elec-

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trical massage, in the early treatment of tuberculosis, in chronic bronchitis, and in cases of so called "weak chests."

One of the earliest, most important, and gratifying results obtained by me after beginning to use electricity regularly and largely was the discovery that it was a safe and powerful hypnotic. This fact was doubtless known to everyone who had used electricity to any extent, but it came to me with startling distinctness. Even when the electrical treatment was given in the morning a good night's sleep was almost sure to follow.

One case gave me a complete surprise. A gentleman who was in charge of a very large business came to me with symptoms of nervous trouble indicating a serious nervous breakdown. He had been troubled for twenty years with an ozæna that had been very offensive. After using the cage over the head for about two months he said to me that his catarrh had entirely vanished. He had been subjected to the treatment of the best specialists with only a temporary relief.

One case of varicose veins in a young woman who was a clerk in a bakery especially interested me. She was unable to stand at the counter, and was taking an enforced vacation when she came to me. Electrical massage, using the galvanic current, for nearly three weeks entirely relieved the varicose condition, and now after three years there is no trouble.

In one case of chronic ovaritis the removal of the ovary was averted and a condition of comparative health and comfort was restored by electrolysis. The positive copper electrode was used within the uterus, the negative, indifferent pole was used over the ovary.

In facial neuralgia it will eventually be recognized that operative interference is unnecessary. In one case the inferior maxillary, then the superior maxillary, then the ophthalmic branches had been operated on; then the Casserian ganglion had been operated on twice; finally the eye on that side had been removed on account of injury to the optic nerve; but still the agony persisted. After each operation there had been a brief period of rest. The positive galvanic current gave nearly complete relief for many months; in fact, for a longer period than any or all of the operations combined. If the result of this paper should be simply to discourage operative interference in a single case of facial neuralgia I should feel that I had accomplished a satisfactory result. The case of an eminent man

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who to-day would have been one of the bishops of the Methodist church if it had not been for a facial neuralgia is a striking warning against operations for this trouble. He had each of the branches of the facial nerve operated on, and then the Casserian ganglion removed, without any relief to speak of, and to-day is a complete physical wreck.

The use of the static current in muscular rheumatism, sprains, paralysis, as a general tonic, for migraine and nervous headache, lumbago, sciatica, neuralgia, neuritis, neurasthenia, and other nervous conditions has given more satisfaction in my hands than all other remedies combined.

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ELECTRICITY IN THE TREATMENT OF OCULAR AFFECTIONS.

By Maurice F. Pilgrim, M.D., Boston, Mass.

It is not intended in this paper to consider in detail *all* the various ocular affections in which the application of electricity has been found useful. Still less is it my purpose to presume to attempt to treat exhaustively of those ocular conditions in which electricity has been found the most superior therapeutic agent that has been employed. The range of ocular affections is much too extensive and comprehensive to admit of such attempt upon my part at this time. In a brief and necessarily somewhat desultory manner it is proposed to mention, first, some of the ocular conditions in which electricity has proved in my hands the most satisfactory therapeutic agent employed, and then to speak of it in connection with the treatment of one of the most grave maladies known to ophthalmologists, in which its employment has yielded the most brilliant results.

Over twelve years' experience in ophthalmic practice justifies the expression of belief that in some of the more troublesome *external* affections of the eyes—such as keratitis, blepharospasm, stricture of the lacrymal duct, etc.—we have, at present, no agent that can rival, in efficacy, electricity intelligently employed. Let it be understood that the electric current with reference to this group of cases is considered as a *therapeutic*, and not at all as a *surgical*, agent. In the various forms of granulation leading up to the most-marked types of trachoma no surgical procedure has, in my experience, approached in point of usefulness or effectiveness the application to the lids of the galvanic current with the silver or cupric electrode. Indeed, where the constitutional dyscrasia, so often a contributing cause in such cases, could be controlled, or bad general nutrition improved, it is a pleasure to be able to state that I am unable to recall a single case of trachoma, among the large number treated, which was not either cured or markedly benefited by electricity. For what other surgical procedure or therapeutic agent thus far known to the ophthalmologist can as much be affirmed?

In the treatment of corneal ulcers of every variety there is nothing that approaches in effective rivalry a few applications of the galvanic cautery.

So, too, in the various forms of ocular asthenopia, especially the accommodative type, there is, within the writer's present knowledge

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and experience, absolutely no other effective mode of treatment. It would seem that, if the galvanic current were discarded, the ophthalmologist would be left without any efficient means of relief for such cases.

It is to be regretted that nothing of an affirmative character can be offered in this paper respecting the merits of electricity in the various forms of iritis or in lenticular opacities—cataracts. It is hopeful, however, that increasing experience and further experimentation with the electric current may eventually lead to satisfactory results in such cases.

Having hastily mentioned—too hastily, it is feared, to prove valuable other than as suggestive expedients, possibly—some of the more common ocular diseases in the treatment of which electricity has found a permanent place, it is now proposed to speak of it in connection with the treatment of one of the most serious and frequently the most hopeless diseases with which ophthalmologists are called upon to deal.

The treatment and management of glaucoma in any or all of its forms has ever been the *bête noir* of ophthalmology. There has probably never been a disease of the eye about the pathogenesis of which so much has been written and spoken and so little accomplished in the way of effective relief and permanent cure. It would consume the entire time allotted for the sessions of this association were the attempt made to present even a tolerably full *résumé* of the various theories entertained by eminent ophthalmologists, at home and abroad, as to the pathology and causation of this dreaded disease. At the risk of being considered invidious in the selection, the views of a few of the more prominent writers upon the causation of glaucoma will be briefly stated in this connection.

Priestly Smith, after protracted study as to the causation of increased ocular tension in glaucoma, states that it may result from three causes: first, hypersecretion by the ciliary processes; second, serosity of the fluids; and, third, obstruction at the filtration-angle.

Von Gräefe believed increased secretion resulted from inflammation of the choroid, while Donders held that the increased choroidal secretion was due to an influence exerted directly upon the ciliary nerves.

Both Weber[1] and Knies[2] hold that the ciliary processes enlarge

[1] *Von Gräefe's Archives*, volume xx, p. 2.

[2] *Von Gräefe's Archives*, volume xx, p. 1.

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in consequence of venous stasis so as to press at their apices against the posterior surfaces of the iris. Displacing the marginal portion of the iris forward, it becomes adherent to the anterior portion of the sclera and margins of the cornea. The normal sinus of the anterior thus becomes obliterated. Attachment of the iris to the ligamentum pectinatum closes one of the most important exits of the eye,—*i.e.*, into Schlemm's canal,—and, as a consequence, an excess of fluid must remain in the eye. Obviously the *desideratum*, therefore, is to reopen the closed conduit.

Dr. Henry Noyes, of New York, in his revised edition of "Diseases of the Eye," after carefully reviewing the different theories as to the causation of increased tension (which is really glaucoma), gives the weight of his valuable opinion to the "retention theory," thus supporting the views of Knies and Weber, first promulgated in 1876.

Priestly Smith, investigating along the same lines, but at a later date, found, in eighty eyes affected with different varieties of glaucoma, obstruction at the filtration-angle in all but three. He summarizes thus:—

"The causes of primary glaucoma, then, are various and complex, and are not yet completely known, but they are alike in this: they all lead to compression of the angle. With that compression the actual glaucoma process begins . . . the fluid which still exudes from the turgid ciliary body is albuminous and less diffusible than the normal secretion; it tends to accumulate behind the lens, and this latter, being pressed forward, intensifies the mischief. Thus cause and effect react upon each other in a vicious circle."

It being substantially agreed, then, that, whatever the initial cause, defective drainage at the filtration-angle is the immediate cause of pressure, it is important to inquire what is the pathological change that occurs? Ophthalmic surgery has certainly recognized, indirectly at least, the existence of obstruction or constriction somewhere in the region where Knies locates it (the ligamentum pectinatum being bound by exudation to the iris), and treated by removing a portion of the iris. Thus iridectomy became and continues to be the orthodox treatment for glaucoma in the hands of most ophthalmologists.

The *desideratum*, if cure rather than relief is sought, would seem to be the removal of the constriction and the consequent restoration of the normal filtering function of the eye. Can this be

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best attained by destructive procedures—by excision of a portion of the iris? The writer firmly believes not. Until the year 1893, I had performed iridectomy in every suitable case of glaucoma that came into my hands for treatment. I say "suitable" because ophthalmologists have for a long time recognized several forms of the disease in which this operation is not only not indicated, but is useless. In 1893 I had three cases of glaucoma in which iridectomy was clearly indicated, but the patients declined it. There was pain, tension, and reduction of vision, and, while operative interference was declined, the patients still begged that other agencies might be employed for their relief. More as a forlorn hope than with the expectation of success, the galvanic current was used in these cases, and with the astonishingly-happy result of relieving pain and tension, restoring reduced vision, and, apparently, curing the disease. Two years later these three cases were reported in detail by me in the *Annals of Ophthalmology*[1] under the caption: "Is Glaucoma Curable Without Operation?" The subject was treated in an interrogative way, and more with a desire of stimulating ophthalmologists to a further and fuller investigation of the merits of electricity in the treatment of this disease than as a positive affirmation on my part. It was realized that results in three cases could not be considered as affording anything approaching conclusiveness in a matter of such grave importance. The investigation of the profession was solicited in order to determine whether the apparent cures in these cases were the result of a new and novel treatment or were merely coincidental. As the details of my tentative procedure in these cases, together with their histories and results, are fully set forth in the April issue of the *Annals of Ophthalmology* for 1895, I will not ask the members of this association to listen to them now. Although I received a large number of letters, after the publication of my paper, from ophthalmologists in various parts of the country, very little interest was awakened respecting the matter. Few seemed willing or cared to investigate the subject. Dr. George M. Gould, of Philadelphia, a year or two later, announced in a paper his belief that glaucoma could generally be arrested and cured by massage without iridectomy, and in most instances operation was not only unnecessary, but bad procedure. He failed to say a good word in favor of electricity, however, although his attention had been directly invited to its consideration.

[1] *Annals of Ophthalmology*, volume iv, No. 2, April, 1895.

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A distinguished ophthalmologist to whom a copy of the writer's paper was handed by a friend got no further than its title-page, when, after reading the caption "Is Glaucoma Curable Without Operation?" threw it into the waste-basket with the remark that "that man must be a d——d fool." This gentleman has probably performed as many iridectomies as any ophthalmologist in America. It might not be deemed amiss for me to add, in this connection, that four months later I had the satisfaction of treating by electricity one of his dissatisfied patients upon whom he had already performed two iridectomies for the same eye and was then urging the doing of a third, in the hope of relieving pain and tension, but the patient declined. Treatment at my hands with the galvanic current speedily brought subsidence of all glaucomatous symptoms and improvement of vision from $^{20}/_{150}$ to $^{20}/_{50}$ which has ever since been maintained without further treatment—a period of over five years.

In the five years succeeding the publication of my paper (in 1895) I have treated 21 cases of glaucoma (excluding, of course, the hæmorrhagic and fulminating varieties, in which the sight is rapidly and hopelessly lost) with the galvanic current, and in every instance secured better results, both temporary and permanent, than I believe would have been possible through the most skillfully performed iridectomy, and at the same time avoided a disfiguring coloboma of the iris. Were all these cases actually cured or only relieved, it may very pertinently be asked? I should candidly reply that I don't know. Time alone—more time than five or six years—can determine that. But it has never been claimed, at least by the more conservative ophthalmic surgeons, that iridectomy *cures* the disease; it only relieves and postpones the dreaded *denouement*. By excising a bit of iris a new conduit for the escape of the imprisoned fluids at the filtration-angle is provided, thus relieving, for a time, occlusion, and making possible a reduction of intra-ocular tension. This does not, however, deal with the cause, but only with the effects, of the disease. But if pain and tension can be relieved and vision improved without making an unsightly coloboma in the iris, *why make it?* It is a pleasure to me to be able to state before this association that such a result (in varying degrees, of course) followed in all of the cases above referred to. It is not contended that the results in all of them were *ideal*, but that they were more satisfactory than iridectomy was likely to have produced, and an unsightly coloboma was thereby obviated.

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Leaving now the further consideration of what may not inappropriately be designated the *practical* side of the treatment of glaucoma by the galvanic current, I wish to conclude this paper by a brief statement of some of the *theoretical* reasons why we have a right to expect electricity to be efficient—efficient beyond any other known agent—in the treatment of this disease.

In the treatment of glaucoma, as in many other diseases, the object sought is the restoration of physiological function. In its treatment two methods, it seems to me, are presented: 1. Restoration of function by changing perverted to a healthy local nutrition, and removal of the products of malnutrition. 2. The destruction of such products surgically. By the former method, if we succeed, we cure the disease, whereas, by the second procedure, we should expect only to relieve, and possibly arrest its continuance. And this is precisely what iridectomy offers the ophthalmologist, and usually nothing more. But the galvanic current promises very much more. It not only absorbs the exudation and thus liberates the filtering angle of the eye, but by its sedative or stimulating properties (depending upon our diagnosis as to whether, in a given glaucomatous attack, chemical exchanges are "overactive" or "underactive," because they are not the same in every case) it favorably modifies the nutritive processes. While iridectomy meets the demand, temporarily, for more room, it neither modifies nutrition nor causes absorption of occluding substances. That galvanism is capable of accomplishing both of the last-named requirements would seem to require no argument before a body of electro-therapeutists. By iridectomy physiological function is only re-established by removing a part of the iris, and is thus made to act vicariously, inasmuch as it is not claimed to be the primary offending or obstructing cause of the disease. If the views of those ophthalmologists who hold that the pathogenesis of glaucoma is interference with the nerve-nutrition of the eye be correct, it is apparent that iridectomy cannot promise us theoretically anything in comparison with galvanism, either as a means of relief or cure.

Liebig, writing of the "vasomotor effects" of electricity, says:—

"It has been mentioned that the galvanic current produces variations in the calibre of the blood-vessels at the points of the application of the electrodes. Similar modifications of the vascular calibre are produced by a stimulation of certain nerve-centres."

And again under the head of "Trophic Effects" he says:—

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"Although our knowledge of a trophic system of nerves is still very indefinite, we may assume the existence of such nerves to aid us in explaining the phenomena of nutrition. Whether galvanism has any effect upon the trophic nerve is immaterial in the face of the fact that it undoubtedly has a decided influence upon nutrition. Atrophies of organs or tissues often are favorably modified by the galvanic currents."

An iridectomy has only to do with the *sequelæ* of the glaucomatous attack by affording room for the re-establishment of physiological function. Manifestly it neither affects nor alters the neural impulse upon which the continuance of the disease is believed to depend. Neither does it regenerate the affected area by restoring impaired function. Is not galvanism, according to our understanding of its capabilities, able to meet both these requirements, and simultaneously? If this contention is conceded, it would clearly follow, therefore, that the better would be the more physiological treatment, of attempting the absorption of the products of a glaucomatous attack rather than to pursue a roundabout and vicarious method, as is done with iridectomy, thus permitting the anatomical restoration of the affected parts and the consequent re-establishment and resumption of physiological function.

(NOTE: The Editor of the Transactions very pertinently suggests that a word be said about polarity and current-strength in the treatment of the cases above mentioned. I rarely exceeded 15 milliampères, usually commencing with not over 5 milliampères and gradually increasing during the twenty minutes' *séance*.

The positive pole, while it would unquestionably more rapidly deplete the eyeball of excessive fluidity, would yield only temporary results, even if not followed by injurious reaction. Inasmuch as *permanent* relief from the pressure of excessive fluid can only come through greater activity and tone imparted to the absorbents, the negative pole has always been applied to the eyeball. In the two instances in which the positive pole was tried for a brief time only, the results were highly unsatisfactory, and if long continued would, in my opinion, have proved injurious.

A colleague queries whether the results obtained in my cases may not have been due to "psychic" force or influence rather than to the galvanic current. The more liberal element in the profession is coming to recognize the plurality of agencies in the curative process. Some surgeons grudgingly, if at all, concede curative power to drugs,

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while "drug-givers" are loath to admit the efficacy of electricity. As an electro-therapeutist, I cheerfully admit my belief in the potency of psychic force to make many beneficial changes in the human organism, and am not prepared at present to define its exact limitations. If my critical colleague or his *confrères* will relieve and *symptomatically* cure glaucoma without drugs, the knife, or electricity, he will have answered his own question more satisfactorily to himself than I can. But until he demonstrates such power, he is, in all fairness of reasoning, bound to concede the results, as epitomized in the foregoing paper, as due to the therapeutic quality and power of the electric current.—M. F. P.)

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SOME GENERAL STATISTICS OF STRICTURES OF THE URETHRA TREATED BY ELECTROLYSIS.

By Robert Newman, M.D., New York,

Ex-President of the American Electro-Therapeutic Association; Consulting Physician to the Home at Yonkers, N. Y.; Consulting Surgeon to Hackensack Hospital, etc.

The object of this short paper is to show that electrolysis in the treatment of urethral strictures has been continuously practiced with equal success as heretofore, and to add general statistics. The writer finds this necessary since for several years he has said nothing about his statistics, and in six years[1] not read a paper on the subject before this association. Longer silence might me misconstrued by some members of the profession. Further experience has shown that there is nothing to retract, only confirming former statements of success in the electrolytic methods.

The writer has used successfully his method of electrolysis in the treatment of strictures in about two thousand cases, which is not a large number for thirty years' active service, as it would average not more than five cases per month. Seven years ago he published a compilation of 1755 successful cases in the practice of fifty-four different operators,[2] mentioning their names, and favorable opinions of said method. In the same number appeared an editorial from which the following is quoted: "The statistics accumulated by Dr. Newman, if all were reported, would cover a list of over two thousand cases of urethral stricture treated by the electrical method. In the face of such a mass of positive evidence one is tempted to explain the dissent existing by the application of the personal equation. Still, everyone has his right of opinion and free expression; and if the opponents of this method desire it, the columns of the *Times and Register* are equally at their service." No statements of dissent have been sent, and the writer gave documentary evidence for everything stated, which was investigated and found correct by an impartial committee from this association, who reported accordingly. Many of these patients have been kept under observation, have been re-examined after years, and no relapse found. Most of these after twenty-five years' interval, can be found to-day, stating

[1] "Supplementary Report on the Success of Electrolysis in the Treatment of Urethral Strictures." Read in New York, September 26, 1894.

[2] *Times and Register*, Philadelphia, April 8, 1893.

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themselves that they have kept well without having had a relapse. A few of such patients returned after years with a new ailment, mostly of the prostate or bladder, but never had a stricture in the same place which had been cured by electrolysis. During these thirty years the writer has never lost a patient by death while under treatment for a stricture. One patient having a stricture died from injuries received in a falling elevator, and before any treatment for the stricture had been commenced.

Death, however, followed in every instance when a patient gave up the electrolytic treatment by the writer for the sake of undergoing a urethrotomy, which in these cases never was performed by the writer, but by most skillful surgeons of unquestionable ability, who did the work well. The operators cannot be blamed for the fatal result; but we must accuse the system. The causes of death in these cases were mostly sepsis and uræmia, after a secondary hæmorrhage. Cystitis and suppression of urine had preceded. Nowadays the greatest advocates of urethrotomy will not guarantee cure, and patients so operated on will remain patients till the end of their lives. Any cutting either heals up by first intention, which makes the calibre of the same size as before, or, if the divided surfaces are kept apart, a cicatrix by granulation is the consequence, which is worse than it was before the cutting. It is useless to give these cases in detail, which were only received by the courtesy of the operating surgeon, and has only reference to cases known by the writer. Other methods may cure some strictures which are only contraction, within the urethra, but it has not been proved that fibrous pathological conditions of induration, invading tissues outside the urethra, and even the corpora cavernosa and spongiosa can be removed by cutting, divulsion, or dilatation.

Electrolysis absorbs the fibrous infiltration by the chemical action of the negative pole. The writer has often demonstrated such decompositions by electrolysis, and it is taught in any text-book on physics and chemistry. In surgery the rule is: weak currents will absorb. Strong currents must cauterize and destroy tissue.

Hence it follows that, for the treatment of urethral strictures by electrolysis, we must use a weak current, never more than 5 milliampères, and depend principally on the action of a galvanic chemical absorption. Such currents never can burn.

Electrodes and battery must be made correctly and in accordance with our principles, as described in former papers; no force or

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pressure be used; no hæmorrhage caused; and cases must never be operated upon during any acute symptom. No pain or inconvenience must be caused, and the *séances* not made oftener than once a week.

Is it Dilatation?

We protest against having the process of electrolysis called a dilatation or a modified dilatation. It is not dilatation in any sense, which is an entirely different action, in which some kind of force or pressure is always used and is absolutely necessary. Any force in electrolytic applications is a great error.

To show the difference between a dilatation and an enlargement, a quotation from a dictionary may be permitted here:—

Dilatation. The act of dilating or expanding; expansion; augmentation of bulk; spreading in all directions.

Enlarge. 1. To make larger; to increase in quantity or dimensions; to extend in limits; to expand.

2. To increase the capacity of; to expand; to give greater scope to.

3. To become too diffuse; to expand.

4. To set at large; to release from confinement or pressure; to give freedom to.

It will be seen that the term dilatation is not within our meaning, and by former usage reminds one too much of the gradual dilatation with sounds, which needs pressure, and is scarcely anything else than the momentary stretching of rubber, which, released, goes back to its former calibre. What we want is a permanent enlargement, by absorption of pathological conditions.

In electrolysis the electrode passes by simply holding and guiding it through the stricture. It enlarges the calibre by the absorption, and consequent restitution of the size. This absorption of the fibrous tissues goes on gradually, relieving the stricture and enlarging the calibre of the urethra until it is restored to its normal size. The operation must never be done when there is present any inflammation, hæmorrhage, or discharges. Under such disadvantages failure must follow. If there are excoriations, the electricity will hurt, and such conditions must be cured first by other means.

Diagnosis is most important, and must be made so that there will be no doubt that we have to deal with an organic stricture. Spasmodic strictures will be made worse by the galvanic current. Other differentiations are granulations, discharges, diseases of the prostate, lacunæ in the urethra, calculus, and carcinoma.

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The *modus operandi* and the armamentarium have been described in former papers.[1]

If failures are reported, the operator has made mistakes, for which the system cannot be responsible. Recently many more successes of electrolysis have been reported, and papers on the subject published. It is, among others, pleasant to mention the excellent papers of Arthur B. Duel, M.D., in the *Journal of Electro-Therapeutics* for July, 1900, p. 185: "On the Value of Electrolytic Dilatation of the Eustachian Tubes in Chronic Tubal Catarrh and Chronic Catarrhal Otitis Media." Dr. Duel has made a valuable addition and a clear description of electrolysis, and says, on p. 188: "Dr. Robert Newman has demonstrated its great value in the face of most bitter opposition."

There is much truth in those lines, but it must be wondered why such opposition is manifested, after reports of success with the method for over thirty years by many different operators. It will do no good to argue and enumerate causes. However, one good reason is the failure of our medical colleges to include in their curriculum electro-therapeutics, preferring to hunt microbes and bacilli. One college faculty, who have new buildings and excellent laboratories, have not fulfilled their promises given for six years, to include electro-therapeutics in their curriculum. The secretary of another great college told me that they have a battery in their laboratory!

The want of education and just appreciation of the power of electro-therapeutics is well and concisely described in an editorial in the *Charlotte Medical Journal* for February, 1898, p. 178. Other failures arise from the want of patient, correct manipulations, and the fact that the operator is not an electrical expert and genito-urinary surgeon combined. The careful graded education for years, in the laboratories of the University of Michigan at Ann Arbor, under the able leadership of our fellow, Dr. William J. Herdman, deserves, therefore, our greatest approbation and encouragement.

Many kind words have been said about this method, too many to

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[1] "Ten Years' Experience in the Treatment of Strictures of the Urethra by Electrolysis," *Medical Record*, New York, August 12 and 19, 1882. "The Armamentarium for the Treatment of Urethral Stricture by Electrolysis," *New England Medical Monthly*, March 15, 1887. "Twenty Years' Retrospect in the Treatment of Urethral Strictures by Electrolysis," *Journal of Electro-Therapeutics*, New York, January and February, 1891. "Electrolysis in Urethral Strictures," R. I. Medical Science, January 7, 1894.

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repeat here, but only one may be permitted to show some cause of failure. Dr. H. H. Hahn, of Youngstown, Ohio, read a paper before Mahoning County Medical Society[1] in which he says as follows:—

"In addition to this, there is such a thing as a special aptness for certain kinds of work, and, when this is associated with the other requirements mentioned, the claims we have made will certainly be verified. The venerable and grand Dr. Robert Newman, of New York, who has so successfully treated hundreds of cases of stricture of the urethra by electrolysis, has been striving for years to force upon the profession at large just how he accomplishes it, and yet we find men here and there decrying the method as inefficient and dangerous, claiming that they had tried it, and in some instances exposing their abominable ignorance by admitting that they had produced cauterization, and that the treatment was followed by a worse stricture than the one it was attempted to cure. We simply say that Dr. Newman does not cauterize with his own hand, and, when some fool, through his ignorance and clumsy manipulation, does so, neither Dr. Newman nor his method are responsible. It is the operator alone, and that, too, in spite of clear and explicit directions in every detail laid down by Dr. Newman. All we demand in this matter is fairness."

There are numerous advantages of electrolysis in the treatment of urethral strictures which have been set forth in former papers. The principal one, however, is that it cures, and, once cured, no relapse is possible. The patient is not kept in bed any time, and loses no time in business or pleasure. All of which has been proved by documentary evidence during thirty years.

Drs. Holloday and Burton report successes, and close their good, concise paper as follows: "The above statements are not the wild vaporings of an excited imagination, but sober conclusions formed from a long experience, a practical structure reared upon the rock-bed foundation of the eternal, unchangeable laws of physics and chemistry, woven by man's ingenuity into the applied science of electro-therapeutics."

148 West Seventy-third Street, New York.

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[1] *Journal of the American Medical Association*, March 25, 1893.

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ELECTRO-THERAPEUTIC SINS.

By Rev. H. Newman Lawrence, Stapleton, N. Y.

Sin is the transgression of the law (I John iii, 4). Therefore electro-therapeutic sins are transgressions of the laws of electro-therapeutics. These laws are many, for they embrace nearly all electrical laws, a large portion of the general therapeutic laws, and a number of special laws born of the combination of electricity and therapeutics. Any enumeration of these laws is beyond my province, would occupy too much time, and would partake somewhat of the nature of an insult to my hearers, who are well acquainted with them already.

The transgression of these laws may be either willful or ignorant. Both may be classed as sins, and let me add that there is such a thing as *willful* ignorance, and this is, perhaps, the greatest sin of all.

Although I suppose that I am confined by the title of this paper to scientific sins, yet I cannot refrain from mentioning that electro-therapeutic laws are subject to the great moral law of right and wrong, and that nothing can override the divine law of duty to God and duty to our neighbor.

In so far as the large majority of the members of this association are physicians and surgeons it is manifest that there is no need to say much about transgression of therapeutic laws. The diploma which each possesses from his *alma mater* testifies that he knows the laws; and the high ethical principles which distinguish the profession as a whole are evidence that he does not transgress them.

When, however, the physician or surgeon comes to apply electricity to his therapeutics, the conditions are widely different. His diploma does not cover electrical knowledge. His regular course of instruction either did not teach him electrical laws or only gave him a very meagre and imperfect acquaintance with them.

Herein lies a great temptation to electro-therapeutic sin. Shall he use electricity in his practice without first gaining a reasonably full knowledge of its laws? If he yields to such temptation, he is clearly guilty of electro-therapeutic sin. His position would be analogous to that of a physician who had somehow obtained his diploma without possessing any knowledge of medicinal chemistry, and then proceeded not only to prescribe medicines, but also to do his own dispensing. If an electrician presumes to prescribe and apply elec-

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tricity to the human body when he is ignorant of therapeutics, he at once meets *and deserves* the condemnation of the medical profession; but, granted that he is a *bona fide* electrician, it seems to me a question of fine casuistry as to which is the greater sinner: the physician who practices electro-therapeutics without knowledge of electricity, or the electrician who practices electro-therapeutics without a knowledge of therapeutics.

When the busy physician finds it necessary to intrust the carrying out of the electrical prescriptions to an assistant, it is very necessary that he exercise due care that such assistant is qualified to carry out his instructions; otherwise, if not actually a sinner himself, he is at least "an accessory before the fact."

Whatever may be said of science in the abstract, it is certain that applied science cannot be scientific unless that which is applied is measured. Electrical energy can be measured, and is, moreover, sold by certain units of measurement. The laws of electrical measurement are well known; so that to apply electricity to therapeutics without measurement is to be guilty of electro-therapeutic sin.

There are other kinds of sins that, though perpetrated under the name of electro-therapeutic, are not really electro-therapeutic at all; but, inasmuch as they cause great wrong to the public under cover of the name, it may be well to say a few words about them here. Belts or other body-appliances bearing the name electric or magnetic and claiming to apply electricity to the body are, with scarce exceptions, frauds, and those persons who sell and recommend them are guilty of electro-therapeutic sin of the grossest kind. That these appliances violate all laws, electric and therapeutic, has been frequently pointed out, but as such exposures seldom get beyond the technical journals, the general public can hardly be said to be influenced by them. Still, as attention cannot be too strongly drawn to the matter, I will briefly restate the main facts.

A very large proportion of these so-called electrical appliances are so badly constructed or so marvelously connected that they cannot, by any possible chance or mischance, produce electric currents. Some bear their own condemnation upon their faces, for they are announced *as never wearing out and never requiring renewal.*

The only way in which an electrical appliance can benefit the body electrically is by producing *electrical energy capable of doing work* upon the body, in the same way that an electric-bell outfit must produce electrical energy capable of doing work upon the bell: *i.e.*,

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make it ring. There must be a source of energy in the apparatus, and that source requires to be renewed from time to time as the energy produced by it becomes exhausted. In other words, we must have an electric battery, and the electric battery which will never wear out, or run down, as it is called, has yet to be discovered. Science says clearly and definitely that energy cannot be created; it may be transformed, changed in character, as from chemical to electrical in the galvanic battery, but it cannot be obtained or created from nothing. Any electrical appliance, therefore, which professes to *never* need electrical renewal is a *fraud.*

Let us take an illustration from the typical electro-magnetic appliance. We have one or two or more strips of magnetized steel sewn into garments or bands, and we are told that the presence of these magnets causes electric currents in the body. Now, while it is quite true that electric currents may be produced in a conductor which is in proximity to a magnet, it is also true that in order to do this one of the two must be moved relatively to the other. Either the magnet must be moved relatively to the conductor, or the conductor be moved relatively to the magnet. Without such motion no current can be set up in the conductor. Were it otherwise there would be no need to employ large steam-engines, or water-motors, or seek the power of Niagara Falls to drive dynamos for the production of large currents of electric-light and power purposes. All that would be necessary would be to place magnets near the conducting wires and then to draw off all the electrical energy required. The absurdity of such an idea is apparent to everyone, and yet when it is put forward in connection with body-appliances many are willing to accept it without question or thought. The body, which is here supposed to be the conductor, when it moves carries the magnet or magnets with it, and there is no relative motion of either one to the other. There is no energy expended in the appliance, and, consequently, no possibility of any electrical influence upon the body. It would be just as reasonable to place a hammer and a nail together, and expect the latter to be driven home without any movement of the former: *i.e.*, without any expenditure of energy.

While on the subject of electro-magnetism it may be well to refer to the fact that magnetism alone has been said to influence the body. Against this assumption (in favor of which not one iota of physiological proof has been ever offered) we have the carefully-

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carried-out experiments of Kennelly and Peterson,[1] who, throughout a long series of tests, found not the slightest evidence of physiological action, even when their subjects were placed in very strong magnetic fields. Further, the startling claims of Dr. Luys, in Paris, as to the curative influence of magnets, were shown by Dr. Hart[2] to be based upon psychological effects alone, *equally good results being obtained from dummy magnets* of wood, etc. In fact, the *suggestion* was everything, and the fact nothing.

Other appliances and devices are to be found which differ from the above only in the point that they do not claim magnetic action. They profess in some other way to do electrical work without any provision for the production of electrical energy, or they are said to act in some hitherto-unknown manner, which even their venders do not attempt to explain, but lead the public to suppose the action (*sic*) to be electrical because they use the word electric or electro as a title. An apparatus of this latter type has recently had a large sale both in America and in England. Its venders have never (so far as I know, and I have questioned them myself) attempted to explain the action claimed for it. Nor can they, for the whole idea is an outrage upon the well-known and oft-proved laws of physics and physiology. Yet this thing is sold freely at more than a hundred times the cost of its materials, and some people who claim to be apostles of light and leading do not hesitate openly to praise and recommend it.

I will pass on to those devices which are, perhaps, even more difficult to deal with, because there is a germ of truth in them. I mean those appliances which are capable of producing electrical manifestations under certain conditions. Now, what are the conditions under which electricity may influence the body: *i.e.*, do work upon it? Physiologists tell us that the properties of galvanic, or continuous electric, currents which can influence the body-structures are the electrolytic, the thermal, and the cataphoric: electrolytic, by means of which the fluids of the body are decomposed or broken up into their constituent parts; thermal, by means of which the temperature is raised either locally or generally; and cataphoric, by means of which substances in solution are passed without chemical change from one part of the circuit to another.

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[1] *New York Medical Journal*, December 31, 1892.

[2] *Popular Science Monthly.*

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To produce these effects we must have a current which *can pass* through the body, or that portion of it which it is intended to influence. The body offers considerable resistance to the flow of an electric current, and consequently any current must possess a proportionate amount of electrical pressure, or electromotive force, as it is called, before it can overcome that resistance, pass into, and do work upon the body. The state of affairs is somewhat similar to that under which a bullet, when simply pressed or thrown against a door, fails to pass through it, but when fired from a pistol, by reason of its velocity or pressure, not only passes through, but is capable of doing work on the other side. Going a step farther, we may point out that, supposing the door to be very thick or have iron sheathing over it, an ordinary pistol would fail to pierce it, but that a bullet from a more powerful gun would easily succeed. For electrical purposes the body may be said to be protected by a semiproof sheathing (the skin), which can only be penetrated by currents possessing considerable pressure on account of the resistance it offers. It would occupy too much time and space to go fully into the consideration of the resistance of the human body. Many authorities have found the value of this resistance under various conditions, but until quite recently no measurements taken under belt conditions had been recorded. Those who have never tried such measurements cannot fail to be astonished at the high resistance of the body under these circumstances.

A short time ago I measured it on several people, using for the purpose a belt which had just been purchased at one of the large establishments for the sale of such commodities. The average resistance was 800,000 ohms; as this particular belt had rather small disks, I will assume that the figures may be less with others whose contact-disks are larger or differently arranged. Let us be charitable and call it half: *i.e.*, 400,000 ohms. To pass even the tenth part of 1 milliampère through such resistance of the body under belt conditions has also been proved to be impossible by Dr. W. S. Hedley,[1] and by expert evidence given at the famous Harness belt trials which occupied the English law-courts at intervals during the autumn of 1892 and spring of 1893.[2]

Such being the resistance, let us see how we arrive at the conclusion that 40 volts is forty times more than such belts are capable

[1] *Provincial Medical Journal.*

[2] *English Electrical Review.*

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of producing. Every belt which depends upon the moisture of the body for its action cannot produce a higher electromotive force—electrical pressure—than that of one couple of the elements of which it is composed, because all the elements dip in the same electrolyte (the body-moisture), and cannot therefore be connected in series. There may be many elements, but the fluid of the body cannot be separated off into cells. It is all in one containing vessel, so to speak, and the only effect of increasing the number of the couples is to practically increase the size of the plates of *similar metal.*

As electromotive force depends only upon the electrical *difference* between the metals used in the same exciting fluid or electrolyte. it follows that the total electromotive force of these couples, be they few or many, is only that of one couple. The couples used in these belts are nearly always copper and zinc, and their maximum electromotive force in the presence of such fluids as body-moistures is *less than one volt.*[1] Other couples may give a slightly-different result, but no combination has yet been found which, with such an excitant, will give over 1 volt.

So far, then, we have an arrangement that may give 1 volt, and which has to act upon a resistance of 400,000 ohms. This, by Ohm's law, will give a possible current through the body of *one-fourth of a thousandth part* of 1 milliampère: an infinitesimal fraction of the smallest current (1 milliampère) recognized by electro-therapeutists, too small for the conception of any but the theoretical mathematician, and less than may be obtained by dipping a needle and a pin in a spot of ink.[2]

The belt-venders sometimes try somewhat to trim their sails to the wind, and declare that their devices are only intended to generate small currents, and that their infinitesimal possibilities may prove useful to the body if the *time* factor is taken into account: that a small electrical influence applied for a long time is equivalent to a greater influence applied for a proportionately shorter time. Imagine having to wear a belt 4000 hours (nearly 6 months) before the effect of even 1 milliampère-hour could be obtained!

In conclusion, I wish to speak of yet another class of electro-therapeutic sins: viz., *testimonial sins.* Here the cultured and the educated, outside the medical and electrical circles, are largely to

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[1] *English Electrical Review.*

[2] *Ibid.*

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blame; and conspicuous, if not chief, among these sinners are the clergy. We of the clergy are bound to make faith one of the chief factors in our teaching and our practice; but it is, or should be, *faith in the truth.* This for the pulpit; but in practice how often do we find that blind faith is put in all sorts of outlandish things, especially in the nature of body-cure-alls, without any effort being made to discover the truth concerning them. In this way some of the vilest electrical quackery has received, not only the approval, but also the public recommendation, of men whose position as ministers of the Gospel gives them considerable influence over suffering humanity. Surely the clergy, above all others, should avoid this sin, remembering that "blind unbelief is sure to err," and that *scientific truth* should be sought for, and can always be found in the revelation that the All-Wise and All-Loving Father has made and is continually making to man, from the inexhaustible realm of nature, for the good of mankind, the relief of suffering, and the cure of disease.

DISCUSSION.

DR. G. BETTON MASSEY, of Philadelphia, expressed his gratification at this presentation of the sins of electro-therapeutics, particularly as it showed the deep sense of duty of the author. He hoped these remarks would receive wide publicity.

DR. W. S. WATSON, of Fishkill, N. Y., also expressed his appreciation of the author's remarks, and sincerely hoped that they would find their way into the newspapers, as in this field they would do much more good than if published in our medical journals.

DR. GEORGE E. BILL, of Harrisburg, said that the newspapers would not feel disposed to publish these strictures on the testimonial-givers, because this would cut into their income from advertisers.

DR. ROBERT NEWMAN, of New York, characterized the paper as a most important contribution to electrotherapy. Our best medical college, so called, positively refuses to include electro-therapeutics in its curriculum. He had made personal efforts to secure a reform in this direction, but so far to no purpose. In his presidential address before this association he had shown the results of an investigation of the deficiencies of our three hundred medical schools. The older physicians had never been taught physics or the rudiments of electro-physics. This was one of the greatest obstacles to progress in electro-therapeutics. If the public could be made to understand the value and true limitations of electro-therapeutics, a great deal would be accomplished. Much could be done in this matter of education, especially by the clergy, and for this reason the paper just presented was particularly acceptable to this association.

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SOME NEW APPLIANCES FOR X-RAY WORK.

By E. W. Caldwell, E.E., New York City.

The first appliance exhibited was an improved stand and holder for the x-ray tube. The latter, instead of being held with a screw-clamp, is securely held in a forked piece of wood by easily graduated pressure made by a coil spring. A most interesting and ingenious device was a wooden shelf or adjustable table for supporting the arm firmly no matter what its position. This shelf is supported on a ball-and-socket joint, and by means of two or three simple attachments the arm, forearm, and hand can be prevented from twitching or trembling, and the photographic plate can be easily placed parallel to the condyles. Considerable difficulty is often experienced in obtaining good x-ray photographs of the pelvis and hip-joint. To facilitate getting the two limbs parallel to each other and to the plate, each limb is strapped to a small wooden table, and the latter are joined in such a way that, when the injured limb is put in the desired position and clamped, the well limb will be parallel to the other for purposes of comparison. The speaker said that in taking x-ray photographs the plate is often injured by the moisture of the body. The best and cleanest way of preventing this is by interposing between the patient and the plate a thin sheet of celluloid such as can be procured at the artists' stores. This material is clean and water-proof, and is very transparent to the x-ray.

DISCUSSION.

Dr. Charles O. Files, of Portland, Me., asked if it was possible in most cases to secure a good picture of the head of the femur. He had tried this a good many times, and with indifferent results when there was much adipose tissue. He was under the impression that it was only exceptionally that one could get a good picture of the head of the femur.

Mr. Caldwell replied that it was always difficult to get such a picture, even with a young and lean subject, but in the majority of cases it was possible to get a picture sufficiently good to show whether there is present a fracture of the neck or any extensive necrosis of the head of the femur or of the acetabulum. With a fleshy subject having small bones it was decidedly difficult. The best picture of this kind that he had made had been of a man weighing 150 pounds, and this had required an exposure of six minutes. The longest exposure in such cases that he used was fifteen minutes, though with children one minute was often sufficient. In most of his work the x-ray tube had been excited with a coil, and he preferred this to the static machine, as he found that he could obtain certain results with the coil that he could not with the static machine. He would admit, however, that some of the most beautiful radiographs that he

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had seen had been made with the static machine. For an extremity the static machine was excellent, and perhaps gave rather better definition than a coil, but for the hip-joint he personally preferred the coil.

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X-RAY PHOTOGRAPHY.

By Eugene R. Corson, B.S., M.D., Savannah, Ga.

The most important thing in x-ray photography is an apparatus which generates powerful x-rays, for it is both your camera and your sunlight; the rest of the process is easy enough. Unless you have an apparatus which can produce rays powerful enough to penetrate the bone itself you can never get fine bone-details in your skiagraphs, and your pictures will not be first class, no matter how skillful you may be in your photographic technique. I have seen much written about the great care necessary in carrying out all the steps in the photographic process, and the long and careful development of the plate; but, unless the x-ray apparatus is a superior one, all the skill in the world cannot make up for weak rays, and what holds good in ordinary photography will not hold good in x-ray photography. In the ordinary plate exposure in a weak light, say, with the plate underexposed, all the points of the object or picture have at least had a certain exposure, however weak, which careful development may encourage and bring out. But with the x-ray, unless the radiation is strong, the bone is not penetrated, and certain important details have had no exposure at all, and cannot be brought out in the development, and I take it that a skiagraph which simply gives mere bone outlines is not first class and should not satisfy the skiagrapher.

This being admitted, every effort should be directed toward obtaining and working properly an efficient apparatus, and the rest will be easy enough. I shall, therefore, attempt, in this paper, to give the results of my own experience in this matter as far as it goes, and to indicate the direction in which progress seems to be advancing.

I began my x-ray work with a ten-inch-spark coil made for me by Willyoung & Co., energized by twelve storage cells, using on it first an Apps vibrator and a simple Queen tube. I got limited results, no matter how carefully my plates were treated, and they were turned over to a skilled photographer who had taken many prizes for superior work. A certain improvement followed my changing the Apps model for the Queen independent vibrator, and the simple x-ray tube for the Queen self-regulating model. My results were still limited and far from first class. I then changed to a fifteen-inch-spark coil made by the same maker, using on it the same vibrator and the same tube, and energized by the same cells.

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On first testing this coil I was greatly disappointed to find that I could not get a spark over ten inches from it, for I was under the impression that my x-ray intensity depended upon the length of spark, and that a fifteen-inch spark was a third better than a ten-inch. There was a great difference, however, in the character of the spark. In the first coil it was a thin spark and intermittent, while with my new coil the spark was a much thicker one, often multiplied, and quite continuous. Now, when I came to test the x-ray and photographic effects I was rejoiced to find the greatest difference in my results. It was very evident that, though the spark was no longer than in my first coil, the amount of current going through the tube was vastly more. The platinum would more quickly become hot, my tube would get much hotter, there was a brighter cathodal illumination, and not only was the time of exposure for the plates much shortened, but I was getting negatives of greater brilliancy and sharpness, and a great deal of bone-detail, and no matter how thick the bone, provided it could be brought close to the plate. This taught me that mere spark-length was no index of x-ray efficiency, and that other factors had to be considered. The long-spark heresy has had its day, or will soon have had.

With better-made coils came Wehnelt's invention to throw more light on the subject. This interrupter, by enormously increasing the number of interruptions, also increased greatly the amount of current going through the tube, and with it a great increase in x-ray power, as tested by the photographic plate, for by the fluoroscope alone the increased efficiency was not so apparent. Using the Wehnelt interrupter on coils of only two- or three- inch spark-length, it would melt the platinum of the tube if the current was continued for any length of time. Greater x-ray efficiency was noticed with the greater current. It was, moreover, soon discovered that the Wehnelt interrupter did not increase the spark-length, but that the difference was solely in the quantity of current going through the tube. Examine with a magnifying glass the photograph of the spark of the Wehnelt interrupter, and you can make out a great many individual sparks. In one I counted at least fifty.

The valuable invention of Mr. E. W. Caldwell was in the same direction, and from what I can learn it is an improvement upon the Wehnelt model. However, the principle involved was the same, namely, by increasing enormously the number of interruptions there was a corresponding increase in the quantity of current per unit of

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time going through the tube, and a proportional increase in x-ray and photographic power.

It taught us the lesson that, in coil-manufacture, after a certain length of spark was attained every effort should be toward increasing the ampèrage, and up to the limit of the tube's endurance; that a ten- or twelve- inch spark is certainly quite enough if your spark is a fat, or multiplied, one: that is, has a relatively-high ampèrage.

Mr. Elmer G. Willyoung, in a letter to me, writes: "I have always felt the prime question of the design of coils to be the supply of sufficient amount of energy at an electromotive force great enough to break through. Excessive spark-length, in my opinion, has nothing to do with the matter, and is, in fact, quite useless, inasmuch as the pressure at the terminals is bound to be cut down by reason of the tube's resistance being lower than the full air-gap resistance which the tube replaces. As a matter of fact, the average fifteen-inch coil being operated on a tube is not more than an eight-inch coil. Since now the total electromotive force being generated must be the same (or practically so) as when the full spark-gap without the tube is used, it follows that the resistance of the circuit is only one-half, roughly, what it should be at full spark-length and plain air-gap. But the electromotive force at the terminals of the tube is undoubtedly an eight-inch voltage. Hence the average fifteen-inch coil and the average tube are equal to an ordinary eight-inch coil giving out twice the ampèrage that such coil would ordinarily give. For, as you know, the line of coils is generally designed to give the same ampèrage for every coil, the only difference being the electromotive force. Hence I argue, and this has always been my position, that the most valuable coil would be one designed for a suitable spark-length, —say, eight or ten inches at the outside,—but wound with a heavy wire so as to pass heavy currents. The difficulty, from the manufacturer's point of view, is that the 'big spark-length' heresy is so rooted that it is almost impossible to shake it. Each succeeding man wants to outdo his predecessor: eighteen-inch coils and then twenty-inch coils, and recently I heard of some one who is having a twenty-five-inch coil made. I have absolutely refused to make anything larger than the fifteen-inch except on the sole responsibility of the purchaser, nor have I been willing to assume any of the experimental expense, inasmuch as I have not cared to put anything of this kind on the market, since I have no belief in it."

With these inventions before us and the evident direction that

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progress in technique has taken, I cannot understand the continued use, by some, of the static machine in place of the powerful coil. The electrical excitation of the static machine depends upon the potential induced at its terminals; so that, when used on a tube where the vacuum and resistance are low,—the tube, by the way, best adapted for photographic work,—there is not enough current generated, and, although the spark-gap in series with the tube, by increasing the resistance also increases the output of the machine, more energy is lost in the spark-gap than is utilized in the tube. Even if you can get a twenty- or thirty- inch spark, it is too thin to do the work, it is *tensio et prœteria nihil*, voltage and nothing else, and you do not get a sufficient quantity of current through your tube to produce the best results. My experience may be limited, but I have yet to see really fine skiagraphs of the more difficult parts of the body, with fine bone-detail, done with a static machine. The German authorities who have written for us the best works yet on x-ray technique, I refer especially to Donath[1] and Gocht,[2] only mention the static machine to condemn it, and Donath's photographic work has been phenomenal. He does an adult hip, and he does it well, in twenty seconds. I can recommend his book most highly. It deserves a good English translation to give it a larger circulation.

I notice in Professor Trowbridge's article in the *Popular Science Monthly*, in which he describes his methods of obtaining sparks of enormous length which may be utilized in x-ray work, he has borrowed a fine skiagraph of an elbow from Professor Goodspeed, done with a coil!

According to Donath, a soft tube of great constancy, and capable of a rapid taking up and giving out of great energy, is necessary for a negative of the strongest contrasts, otherwise the heating of the tube through long passage of the current reduces its capacity even to its destruction. The use, therefore, of the fluorescent or intensifying screen, the *Verstärkungsschirm* of the Germans, accomplishes much by shortening the time of exposure. He also insists that increasing the frequency of the interruptions in the coil also accomplishes the same results.

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[1] "Die Einrichtungen zur Erzeugung der Roentgenstrahlen und ihr Gebrauch," von Dr. B. Donath, Berlin, 1899.

[2] "Lehrbuch der Röntgen-Untersuchung zum Gebrauche für Mediciner," von Dr. Hermann Gocht, Stuttgart, 1898.

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It must be admitted that, for the proper exposure of the plate, a certain quantity of current is, or, let us say, a certain number of interruptions are, necessary to each case, and that the time of exposure is shortened in proportion as the number of interruptions increase.

Experiments with the Wehnelt or Caldwell interrupter fully confirm this. In skiagraphy their value is very great, though the danger of destroying the tube increases in proportion, and requires, therefore, very careful and very quick handling. This makes them quite useless in fluoroscopic work, as the time necessary here would quickly destroy the tube. Donath's experiments with soft tubes show that, unless there is a thick cathode and a strong backing of the anticathode, a blue light appears in fifteen to twenty seconds, and the tube is done for. This interrupter must, therefore, be regarded as unsuited for longer exposures on account of this danger to the tube. Within certain limits, however, the reduction of the time is so great that the tube has not time to change its vacuum, and there is hardly a trace of warming in the tube from the strongest driving in the time necessary for the exposure, provided, of course, the anticathode is well backed.

With the more difficult negatives of the pelvis which Donath was able to make in the laboratory of Dr. Wehnelt, at Charlottenburg, the conditions were less favorable, at least for soft tubes, which at the end of an exposure of twenty seconds showed a tendency to "go under," with the characteristic blue light. While he did a pelvis of a thirteen-year-old boy in seven seconds, the pelvis of an adult woman required a rated exposure with a medium hard tube constant for the first few seconds, but becoming soft at the end of the exposure.

Unless we modify our tube-construction, the new interrupters may be too much of a good thing, and that for safe working the interruptions must be decreased. I am inclined to think that Mr. Caldwell's model is a more practical instrument, and can be more easily regulated and handled, although I have had no experience with it.

As we can measure quantity of current by electrolysis and chemical reaction, so the amount of chemical change in the silver salt in the photographic film is an index of the amount of current going through the tube, and the difference in the photographic effects of high and low vacua is simply the difference in the quantities of the

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currents in the two instances going through the tube, and this difference must be considerable.

Progress in x-ray efficiency must be along this line; in fact, it is already well started in this direction, for the real improvements have been in coil-construction and rapid interrupters, and stronger tubes to stand the increased currents; and it is very evident that we have not yet reached the limits of human endeavor in this direction. We shall have better coils, better interrupters, and better tubes to meet the greater strain.

Using the Queen independent vibrator, I always work it to its highest point of interruptions, removing the bob from the spring to accomplish it, and straining the spring so that I frequently break it, and having always a new one ready for the emergency. In this way with my coil I imagine I get an approach to the Wehnelt effect. I have to use a tube with an extra-thick platinum. With the ordinary Queen tube I have melted the glass insulation close up to the platinum reflector and reduced my vacuum almost to destruction.

The Queen independent vibrator, if modified in certain small details to facilitate the replacing of the spring, I have found most efficient, and, although it cannot give me the very short exposures of the Wehnelt or Caldwell interrupter, my tubes live longer and are not destroyed, and the difference to the patient skiagraphed amounts to very little, for one desirous of having his hip properly shadowed does not mind an exposure of five or ten minutes.

The Queen self-regulating tube I must regard also as the best attainable with present views of tube-construction. I have one I have been using two years, and it is still a good tube. Another in heavy use for six months is also in good condition. My experience with other tubes has not been anything like so favorable.

If Prof. J. J. Thomson and Sir G. G. Stokes, Bart., are correct in their theory of the nature of the x-ray,—namely: that the radiation is a series of electrical impulses given out from a point on the platinum reflector where the charged molecules strike with great velocity and give up their charges, and in my humble judgment their writings are more worthy of credence than any I have seen,—then, I think, it must follow that, the heavier the currents going through the tube, the heavier the charges on the molecules, and, the greater their velocity, the more powerful the x-ray effects. Be this as it may, and however beautiful the theory, my own experience compels me to put down as the first and most important *desideratum* in

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x-ray work: employ a coil of moderate spark-length,—say, ten or twelve inches,—so wound as to give a large quantity of current in the secondary, and with all the current going through the tube which the tube can stand, which means the use of a high order of interrupter, like the Caldwell or the Wehnelt, or the Queen independent vibrator. Using these heavy currents, a proportionately lower vacuum is practicable, and the photographic effects are greater. In other words, within certain limits, with any stated vacuum, its penetrative power is increased by increasing the quantity of current. Always use, therefore, the lowest vacuum which will penetrate the parts.

In my own work I have endeavored to bring out the bones with all the internal detail possible, on a white background, with the flesh and the superficial details wiped out; in other words, I suppress the non-essential parts and bring out the bone with all the contrast possible. Most of the skiagraphs which have come to my notice have not carried out this idea, for the flesh is still in evidence and the printing papers employed are not the best adapted for strong contrasts. It is easier for the imagination to supply the flesh than to leave the bone-details to the imagination. It is the bones we are after.

I secure absolute immobility of the part skiagraphed by binding it firmly to the plate and by placing a heavy weight on the limb to prevent even any movement from the arterial pulsation. The heavy weight accomplishes two things: it presses the bone as near the plate as possible, a most important requisite; and it also, as I say, prevents any possible movement from the pulse. This is all done in a way to make the patient as comfortable as possible. In choosing the side which is to be against the plate select that which brings the bone the nearest, for, the closer to the plate, the sharper the outlines and the better the internal detail.

The proper exposure must vary with each apparatus, and has to be learned after careful trial. I prefer to overexpose than underexpose, for I get the deeper details better. I believe that usually plates are underexposed; I judge so from the prints and from the accounts of long developing. There seems to be a general belief that x-ray plates all require a very slow developing. Some of the best negatives I have ever had have been developed almost as rapidly as the ordinary photographic plate. My own experience is that three to five minutes is quite sufficient, and when the plate takes

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longer it has been underexposed. And this quick developing is done with 2 drachms of 10-per-cent. bromide solution to 8 ounces of developer. If the x-ray is weak and the bone itself has not been penetrated, there can be no bone-details, no matter how carefully the plate is developed; there is nothing to develop.

I have tried about all the developers and have come to regard the hydrochinon with most favor. I seem to get deeper, denser, and more brilliant negatives from it, while the detail is just as good as with the metol. I use for convenience the hydrochinon powders put up by the Eastman Company.

I wash the plate usually two hours, following Carbutt's advice, using also his formula for the fixing with the chrome-alum.

The plate is always intensified, no matter how strong the negative is; otherwise some of the flesh will come out in the print. The intensification is so strong in some of my negatives that they have to be held up to the direct sunlight to make out the detail, and the printing on "velox" paper has to be done in daylight, and even then requiring one or two minutes' exposure.

I use Carbutt's intensifying formula: $^1/_2$ ounce of corrosive sublimate and $^1/_2$ ounce of ammonium chloride in 20 ounces of water. The plate is washed for twenty minutes. A solution of ammonium chloride, $^1/_2$ ounce to 20 ounces of water, is flowed over the plate for half a minute, then washed again for five minutes, and then immersed in an ammonia solution,—2 drachms of aqua ammoniæ in 1 pint of water,—until thoroughly black. Then washed two or three minutes and dried.

Such a negative will print on "velox" paper without any flesh and with a fine black-and-white contrast.

There is often great difficulty in getting the velox print from a highly-intensified negative on account of the great difference in density in different parts of the negative, due to the different thicknesses of the parts skiagraphed, certain parts being overexposed. This can be largely overcome by passing the hand rapidly to and fro over those parts which require less exposure, or in using a shaded screen. Again it is often difficult to print in certain fine details without getting the rest of the print too dark. For example, in a sagittal view of the knee the patella will have to be printed separately before printing the rest of the negative, and, being some distance from the other bones forming this point, this can be easily done.

Even in the hip-joint almost all the flesh can be wiped out if

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the negative is a strong one and has been, in addition, strongly intensified. I have found that the "Carbon Matt" velox is by all odds the best, as being less sensitive than the "special" velox, a very necessary quality when we are striving to get the bone on a perfectly-white background. Although the "velox" print is a difficult one to make, and you will throw away many a print, when you do succeed you have a fine print which will be easy to reproduce in your publications. I must admit that in printing large negatives, 17 x 20 inches, I have used "solio," but had I to prepare such a print for publication I should still use the "velox" despite the labor and loss it might cost.

In my "Skiagraphic Atlas of the Normal Membral Epiphyses" at the thirteenth year I have had a carpus enlarged about two and a half times to show what can be done in the way of preparing large skiagraphs for use in the laboratory and the lecture-room. If your original negative is good you can get fine enlarged skiagraphs, which make the internal detail even more evident, though the outlines may not be so sharp. I show you a carpus, an elbow, and an ankle so treated, and the effect seems to me to be good. You get the bone-designs writ large in strong lines; they give the appearance of charcoal drawings. In this process a positive is made from the intensified negative, and from this positive an enlarged negative, which is again intensified before printing from it.

For diagnostic purposes the fluorescent screen of potassium platinocyanide, the *Verstärkungsschirm* of the Germans, is a most valuable addition to your x-ray outfit, especially when you have a very thick part to skiagraph. This salt gives a bluish light, and acts with greater rapidity on the plate. The time of exposure is shortened, about one-quarter the time being necessary. The outlines are not so sharp, but a greater drawback is apparently unavoidable spots in the screen, due to a lack of uniformity in the coating. In the negative these come out as bright spots and a general mottling. When our object is a correct diagnosis this fault is trivial. With a screen made for me by Ernecke, of Berlin, I get an ordinary hip in one and a half to two minutes.

A field of usefulness for the x-ray which the Germans are working up, and which promises much in the future, is the study of normal osteology and bone-development, and in my "Atlas of the Normal Membral Epiphyses" I have attempted to show what the x-ray can do for us here. It is especially in this line that enlarged skia-

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graphs suitable for the laboratory and the lecture-room will prove instructive as giving us, in strong lines, the internal bony structure, along with the general outlines, and, most important of all, in their exact spacings and relationships. I show you these three enlargements to give you an idea of what may be accomplished in this direction. The only way to do this properly is by the positive and the enlarged negative.

The direct enlargement on bromide paper from the original negative, though a much shorter and simpler process, does not yield as good results on account of not eliminating the flesh and not giving the contrast. I show you an elbow so enlarged, and, though the detail is good, the general effect is not so striking as in the longer process of positive and enlarged negative.

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THE UNIVERSAL ELECTRO-THERAPEUTIC SWITCH-BOARD.

By William J. Herdman, M.D., LL.D., Ann Arbor, Mich.

Simplicity in construction, with greater efficiency in action, is what the practical electro-therapeutist is ever demanding in the instruments that are constructed for his use. Cumbersome, complicated, frail, or ill-devised mechanism has discouraged many a physician and surgeon who has attempted to utilize in his practice the peculiar therapeutic qualities of the various electrical modalities.

It is, in a sense, the duty of those who advocate electrical methods of treatment in preference to other methods so to prepare the way that those who wish to put to the proof such claims can do so with as little obstruction as possible.

It is also desirable that sources of current, control and measurement of current, be made as convenient as possible, in order that like methods of application may become universal, for only after this has been realized can similar results be reached, the work of different operators be compared, and the laws of therapeutic action of the various electrical modalities be revealed.

It is with a view of realizing some of these objects that I have, from time to time, offered suggestions, both verbally and in the form of mechanical devices looking to greater simplicity and efficiency in the electro-therapeutic apparatus that is furnished us by the manufacturers.

The mechanism which I now wish to describe briefly is an attempt to advance one step farther in the direction of simplicity, universality, and exactness in the management of both direct and alternating currents used for therapeutic purposes.

Physicians derive direct electric currents, such as are passed through the tissues of the body, either from the primary battery or the dynamo circuit. A primary battery designed to meet all the requirements of treatments where body-resistances are met with in the circuit must consist of from thirty to sixty cells coupled in series. The electromotive force on the closed circuit of such a battery may be as low as 30 volts, and seldom exceeds 100 volts. The electromotive force on the mains of the direct dynamo circuits, such as are customarily available for the physician's use, are 110, 220, and 500 volts, the former two voltages being those of the direct dynamos used for incandescent lighting, and the last that of the circuits which

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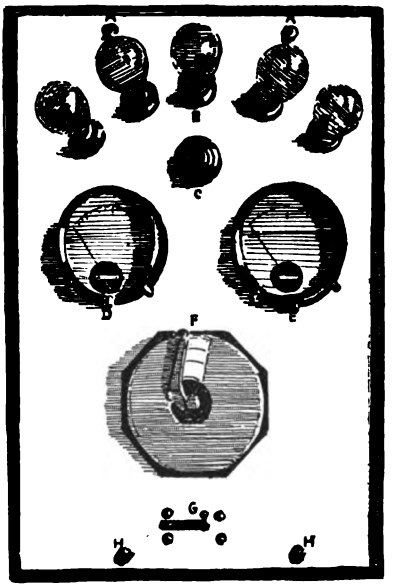
furnish power, run street-car motors, etc. From one or other of these several sources the physician or surgeon derives his direct current for a wide range of therapeutic purposes. Now, if a simple mechanism can be made which will adapt itself to each and all of these sources of current in measuring and controlling that current, the advantages of such an arrangement would be those that I have already pointed out. Some two years' practical experience in laboratory and hospital work with currents derived from various sources has shown me that the arrangement of instruments upon a table-



Universal Electro-Therapeutic Switch-board. *A, A*, Binding-posts for main circuit; *B*, resistance-lamps; *C*, switch; *D*, voltmeter; *E*, milliampèremeter; *F*, graphite controller; *G*, pole-changer; *H, H*, binding-posts for patient's circuit.

plate or switch-board as shown in the accompanying illustration does this in an entirely satisfactory manner.

At the top of the board are seen two binding-posts for connecting the board with the source of current, whether this be a series of batteries or a dynamo. Next in order is a series of lamp-sockets, to which incandescent lamps can be attached for the purpose of introducing resistance into the circuit when it is needed. Below the lamps is a switch which serves to close the circuit through certain

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of the instruments upon the board, and is placed at a point convenient for the operator. Below the switch to the right is a milliampèremeter, and to the left a voltmeter, which are wired so as to measure the current and the voltage in the patient's circuit. Next in order is a graphite rheostat of high resistance in series with the main circuit. Below this there is a pole-changer in the patient's circuit, and finally the binding-posts for the patient's circuit. The patient's circuit is in shunt to the main circuit at the graphite rheostat, so that by moving the radial arm of the rheostat the current may be admitted to the patient's circuit from zero to any desired amount.

It will be seen that, by means of this regulating mechanism, whatever the source of current it can always be delivered into the patient's circuit under the same conditions. After the lamp-resistance at the top of the board has been suitably arranged for the current on the mains so as to adapt it to the range required by electrotherapeutic work, this remains permanent, and needs no further attention. The operator has but to close the switch, thus admitting the current to the board, and then see that the patient is properly placed in the patient's circuit and the pole-changer turned in the direction desired. The movement of the radial arm of the graphite rheostat gradually admits the current into the patient's circuit until the amount of current needed for the treatment is reached. The voltmeter at the same time shows the electromotive force of the current used. When the treatment is ended, the current can be withdrawn in gradations almost imperceptible to the patient by careful moving of the radial arm of the graphite rheostat in the opposite direction.

In connecting up the board to a primary battery circuit having an electromotive force of 50 to 70 volts or less, no lamp-resistance is required; so that the wiring of the main circuit will include only the switch and the graphite rheostat. If the 110-volt dynamo circuit is the source of supply, the central lamp can be wired so as to be in shunt with the rheostat. One path of a divided circuit furnishes a current of sufficient strength which traverses the rheostat, and the shunted lamp serves as a signal that the current is present, and also lights the board. If the 220-volt circuit is used, the central lamp may still be connected in shunt with the rheostat, while the first lamp to the right and left of it should be in series with the rheostat, thus causing a drop of potential to the required amount. When the 500-

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volt direct circuit is employed, the two lamps to the right and the two lamps to the left of the central one should be in series with the rheostat, while the central one remains in shunt with it. By this procedure in wiring the board for the various sources of current a pleasing symmetry of appearance in the lighting of the incandescent lamps is maintained, and the direct current can, by using lamps of suitable resistance, be cut down to an amount which is both safe and sufficient for all electro-therapeutic purposes, with the exception of cautery work.

Alternating dynamo currents of low voltage as far as they are useful in electro-therapeutics can be as readily controlled by this arrangement of instruments as the direct current. An induction-coil can be added to the instruments upon the board if it is wanted, but for my part I prefer to have this as a separate arrangement energized by a battery of dry cells.

It can be readily seen by experienced electro-therapeutists that an arrangement of apparatus which can adapt itself to any source of direct current, which gives a uniform gradation of strength of current from zero to any amount desired, which registers both the amount of current in milliampères and volts, and readily permits of a change in the direction of current, is, both for the purposes of diagnosis and treatment, an improvement on anything that is at present furnished by the instrument-makers.

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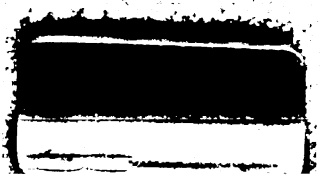

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